PROCEEDINGS

Seventy-Second Annual Convention

OF THE

American Railway
Bridge & Building Association

1967

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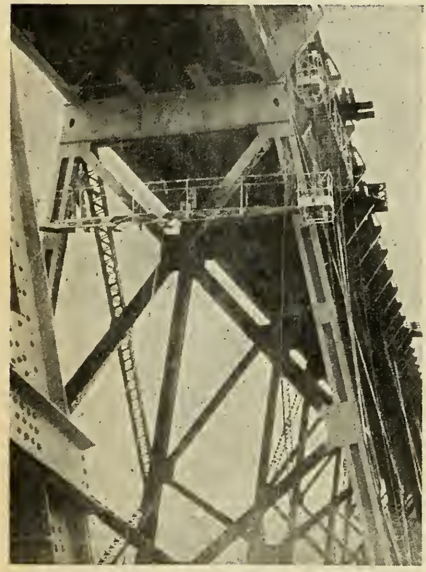

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Proceedings of the

Seventy-Second Annual Convention

of the

American Railway
Bridge & Building
Association

Held at

CHICAGO, ILLINOIS

October 11–13, 1967

Published by the Association
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Terms Expire 1969

*H. F. Lucas, Milwaukee ....Chicago, Ill.

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C. E. Wachter, Canadian National ....Port Arthur, Ont.

*To fill unexpired term of V. D. Raessler, IC, Memphis, Tenn.

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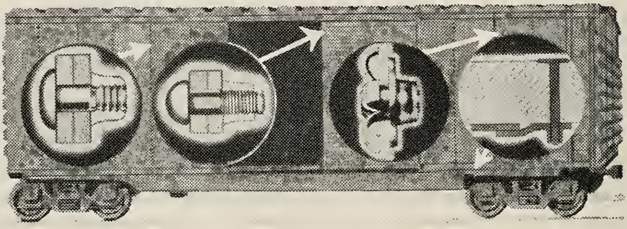

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PROCEEDINGS

The Event—72nd Annual Convention of the American Railway Bridge and Building Association

The Date—October 11–13, 1967

The Place—La Salle Hotel, Chicago, Illinois

The 72 annual convention of the American Railway Bridge and Building Association was held on October 11–13, 1967 at the La Salle Hotel, Chicago. Our convention was held in conjunction with the 79th annual convention of the Roadmasters and Maintenance of Way Association of America.

Except for two half-day joint sessions, meetings were held separately by the two groups and programs consisted mostly of the presentation of committee reports. These proceedings include abstracts, excerpts and in some cases full reports as presented at the B & B sessions.

Also included is a directory of members, the constitution and by-laws of the association and other current and historical information.

Total attendance at the convention was 949 including railroad members of the association, 22 associated members and 37 guests, plus 199 ladies. Registered members of the Bridge and Building Association totaled 301 railroad members and guests.

The joint session on Wednesday was the opening meeting of the convention and featured addresses by T. T. Martin, vice president, Gulf Mobile and Ohio; and R. R. Manion, vice president operations and maintenance department, Association of American Railroads.

Mr. Martin discussed "Your Community and You" and Mr. Manion talked about the future of railroading in his address "There's a Clear Track Ahead."

In pointing out the role an individual must play in representing his industry in a community, Mr. Martin pointed out that almost any industry depends much on the location for its security and future. He also explained that the "factor which more than any other will determine the success of an industry in competition with other industries is the degree of efficiency of its employees. This is the thing that industry has become increasingly concerned about.

"This doesn't mean that industry is looking for cheap labor, but it does mean that it is looking for labor productivity in order for it to survive in this highly competitive world. And industry has found very definitely that it cannot have good productivity from labor which is not happy or which is not, in effect, content in its environment and in its life. No matter what you do inside the plant to make things pleasant, unless a man is happy within his community, unless the community provides for him the things that he and his family feel they need in the way of educational, cultural, spiritual and recreational opportunities, he is not going to be satisfied. And if he is dissatisfied, sooner or later he is not going to be an efficient person," Mr. Martin concluded.

"We are becoming increasingly aware of the possibility of vastly greater dimensions for our industry, of truly broadened transportation systems, with new concepts of service, of volume and different time frames. All of these suggest, possibly demand, the planned phasing in of new processes, operations, equipment and plant, and the organized phasing out of some traditional of some traditional plant and physical limitations," Mr. Manion told the group.

MORE FUTURE TRAFFIC

"There are already indications of where we may be headed, of the nature of some of the problems to be solved. It seems clear that as our country has a growing population, increasing rate of consumption and production, and evidently a continuing involvement in world affairs, the railroads must be 'tooled-up' to economically and efficiently handle more and more traffic.

"While we may see growing congestion placing some constraints on competitive transportation modes, we also see that their peculiar service capabilities will require that we move faster—lots faster-and re-arrange our ways of doing things most significantly, particularly in terminals, as well as over-the-road.

"Successful experience with high-speed passenger transportation will surely lead to high-speed freight movement. (You may make your own definition of high-speed). But, when we have accomplished this, we still must overcome the problems of excessive loss of time in assembly and distribution at origin and destination. You know, this is not an impossible task—we at least have a start with piggy-back and containerization!

"New techniques and equipment in some circles referred to as 'software and hardware,' now available or being developed for assembling and manipulating information, are changing our capabilities to deal with the present and to prepare for and also to influence the future. If our future is to be one of fulfillment of our industry's potential, all elements of the industry must progress equally and must complement each other. We shall not for long have progress in marketing without progress in operating procedures, in equipment development and in the 'fixed' plant.

"I suggest that some times we have gotten a bit out of syncronization in this regard. When that happens, it's difficult to reestablish. I am also suggesting that everyone involved in these endeavors has a responsibility to maintain real harmony of planning and development."

YOUR PLACE IN THE FUTURE

In taking your place on a planning team to provide the future plant which can take full advantage of developments, Mr. Manion pointed out that "you will find it absolutely necessary to be able to employ the latest tools available for planning and evaluation. Now, I have no fears about your ability to adapt to this new situation," Manion said, "the reason that I have no fears or doubts about this is that I was present and saw how you embraced mechanization, and in fact, assumed leadership in this very great change, and in addition, did a bang-up job of selling your management on the concepts and the need for the very considerably investments required. I might also add, that the fact that you are practical people is no deterrent to your employment of these new techniques, but actually will add a necessary ingredient to their use.

"To secure the funds necessary for essential and parallel development of plant with the advances in design of equipment and operating methods, you will find it is an absolute requirement that you justify these expenditures and demonstrate that engineering progress is necessary to permit the realization of the benefits to be secured from progress in these other fields. This, of course, means that you have got to do your home work, and, to be able to clearly show the dependence of each element on the other—that real progress is achieved only when each part moves forward.

"Revolution in railroading is not new to you—this is what you thrive on! With confidence in your industry, through exercise of imagination based on practical understanding, you will not only hold up your end, but will set the pace," Mr. Manion concluded.

SECOND JOINT SESSION

The second joint session included addresses by Edward J. Ward, director engineering research and development, Office of High Speed Ground Transportation, who discussed "where we are headed in high speed rail transportation;" L. W. Menk, president, Northern Pacific, described the "dawn of a new era in rail technology."

Mr. Ward explained that the most important part of their rail R and D is centered around the use of four rail research cars which are operated on the Penn Central between Trenton and New Brunswick. These cars have made a number of runs, more than a dozen, he said, at speeds over 150 mph.

"We find that the ride at 150 miles an hour is very good. You can stand in the car not holding on to anything and get an excellent ride at 150 mph.

"Now, for this good ride it is obvious that you have got to have good equipment. The suspension systems in the cars have got to be in good shape and you must have an excellent track. The Pennsylvania maintenance-of-way people have put in this 21 miles of track to really closer tolerances than they have ever done before and I believe this track is as good as any in the world.

"An interesting thing to me is that this track was completed last November. We have operated over it now for 10 months with well over a dozen runs at 150 mph —our top limit, by the way, is 157 mph— with freight traffic on this every day, normal freight traffic, and only now are we beginning to see any detectable deterioration of the smoothness of the ride. Within the next month or so we will have to do our first minor maintenance.

"I think here we may be seeing an interesting development in maintenance of way. I believe Mr. Piper, chief of maintenance of way on the Pennsy, will agree that this has been a surprise, that we have not had to do maintenance up to now, and it may indicate that putting a roadbed into top shape and really doing an unusually good job to start may pay off in having the roadbed be more stable and stay in line and level longer than a normal installation.

"This is just a quick sample of our research and development program and we have many other projects under way. I hope in the near future we will begin to provide reports through the Federal Clearing House for scientific and technical information that you will all find very interesting," Mr. Ward said.

A WORD FOR THE FUTURE

"It is time we adopted one word, EXCELSIOR, to describe our goals in transportation," L. W. Menk declared in his address to the joint session. "EXCELSIOR, ever onward, ever upward, ever better.

"We are witnessing the dawn of a new era in rail technology, Mr. Menk said, "close at hand are the tools for implementation; computers, marketing techniques, microwave, automatic car identification, unit trains, automated trains and many more.

"If there is any one objective on which all railroad men should reach agreement, it is toward the goal of making railroads the most technologically perfect transportation system this world has ever known.

"It is our responsibility to incorporate into our industry as quickly as possible every technological development that will improve our capacity to serve the needs of American shippers.

"What are our chances of attaining this goal?

"We are going to have to do it in view of the expanding transportation market and the aggressive competition from other modes of transport. There are positive and negative factors which must be considered in future programming for transportation excellence. The path ahead is fraught with problems, but there is an old Chinese proverb that says, 'the longest journey begins with a single step,' and we must initiate that first step now.

MANY POSITIVE FACTORS

"Let us first look at the plus factors.

We have a mechanical advantage implicit in rail movement that makes our costs the lowest of any form of land transport.

"This leverage cannot be discounted. For as our load factor increases, our unit cost declines. Thus, our industry is in a unique position to add to its capacity at relatively low capital cost. Conversely, when an over-the-road track is loaded to capacity, any additional load requires an additional truck with its power source and a driver.

"In contrast, too, with highway transportation, limited now and possibly more in the future by the number of highways offering access to huge urban centers, we have our own privately-owned rights-of-way directly to the centers of our nation's largest urban communities.

"We are just crossing the threshold of experience in the movement of containers. Here is one of the greatest opportunities of our time for intermodal cooperation and exploitation of a service that will return more business to the rails.

"A plus of major proportions is that railroaders have finally realized that they have been channeling too much of their efforts into running a railroad, and not enough into running a business.

"It has taken longer, but the days when railroads measured themselves by miles of track they operated have disappeared as has the day of the heavy gold watch chain and its ornate pendulous fob. Today, any progressive and enterprising railroad worthy of the name must measure itself in terms of market and service.

THE NEGATIVE FACTORS

"Opposed to the plus values there are formidable hurdles acting as a barrier to further accomplishments. We must acknowledge them before we can overcome them.

"To begin with, our forward motion will call for substantial capital investment, and the money just isn't available. The railroads' rate of return on investment is under four percent, the lowest by far of any industry.

"If we are to have a perfect rail transportation system, a prime need will be money. The only way I know to get it is to increase our earning power and attract investment capital. The railroads must be made more competitive instead of less competitive if we are to perform the role our society will demand in the future.

"The only solution to attracting capital, and believe me it will bring the desired results, is to enhance our earning power.

"State and local taxing authorities have long looked on railroads as fair game for discriminatory taxation. They have been so intent on the golden egg that they have lost sign of the fact that the goose must be nourished.

"We carry an added burden in outmoded work rules. It is time to consider how much of that burden we can stand, or can possibly be justified ten years from now, in view of predicted automation in many areas of our operations.

"Regulatory bodies have consistently exerted tremendous pressure for the continuance of passenger service. Railroads have had to tolerate passenger deficits of such proportions as to have a devastating effect on earnings.

"A look ahead, just a short ten years, suggests that the growth of our population alone will compound the problem of transportation many-fold. Highways are already nearing their saturation point. The rails can have the ability and capacity to handle the freight necessary to support our growing America, but it is imperative that under the constantly increasing pressures of our country's growing transportation needs, we have the freedom to operate at maximum efficiency.

NEED PUBLIC AWARENESS

"An objective which I consider to be of first magnitude, if we are to reach our self-set high goals for the railway transportation system, is to make the public more aware of the enormity of the nation's transportation problem.

"How far we can go toward our goal of a perfect transportation system without the ability to diversify is open to question. Certainly, if we can win enough freedom from the compressive restraints that shackle us now so that we can compete equally, it will be a major forward step. But I am not content to believe our responsibility to transportation and to shippers should be confined to movement of goods only by rail. Why not a total transportation system within a single company embracing a choice or combination of rail, truck or barge? Perhaps this is looking too far in the future, but I can tell you this, the day will come.

"The measure of our success will be how well we translate our dream of a technologically perfect transportation system into action," Mr. Menk concluded.

B & B SEPARATE SESSIONS

Separate sessions of the Bridge and Building convention held on Wednesday and Thursday afternoons and Friday morning were presided over by President R. D. Hellweg, asst. reg. engr., Gulf Mobile & Ohio. The following subject reports were presented:

Contracting Bridge and Building Work.

Renewal of Bridge and Trestle Ties Under Welded Rail.

The Wednesday afternoon separate session featured a motion picture showing construction, installation of prestressed concrete girders on the Southern Pacific. Also, the report of subcommittee No. 1—Heavy Construction Equipment, presented on Thursday, included a moving picture on vibratory pile hammers.

During the regular order of business on Thursday Mr. R. C. Baker, past president of the B & B Association and acting chairman of the honorary membership committee, placed the name of Mr. Herb D. Curie in nomination to become an honorary member of the association. There being no dissenting votes Mr. Curie was presented a scroll and accepted as an Honorary Member.

A program highlight outlining recent research developments involving railroad structures was a slide illustrated address presented at the Friday session by Mr. E. J. Ruble, executive research engineer, Association of American Railroads. The text of the address is included in these proceedings. A moving picture on construction of prestressed concrete trestle by the Louisville & Nashville across the Bay St. Louis was shown at the Friday separate session.

ELECTION OF OFFICERS

The following were elected officers of the B & B Association for 1967–1968: President—J. W. DeValle, chief engineer bridges, Southern, Atlanta, Ga.; First Vice President—W. F. Armstrong, engineer of buildings, Chicago & North Western, Chicago, Ill.; Second Vice President—J. A. Goforth, maintenance engineer, Clinchfield, Erwin, Tenn.; Third Vice President—A. R. Dahlberg, assistant engineer, Atchison, Topeka & Santa Fe, Amarillo, Tex.

Treasurer—W. H. Huffman, assistant chief engineer construction, Chicago & North Western, Chicago, Ill.; secretary—Mrs. Ruth Weggeberg were re-elected.

Directors of the Association are:

Term expiring 1968—J. S. Ellis, supervisor bridges and buildings, Chesapeake & Ohio, Grand Rapids, Mich.; T. L. Fuller, engineer bridges, Southern Pacific, San Francisco, Calif.; R. A. Youngblood, general B & B supervisor, Central of Georgia, Savannah, Ga.

Term expiring 1969—H. F. Lucas, assistant engineer, Chicago, Milwaukee, St. Paul & Pacific, Chicago, Ill.; W. L. Short, bridge maintenance engineer, Missouri Pacific, St. Louis, Mo.; C. E. Wachter, bridge and building master, Canadian National, Port Arthur, Ont., Can.

Term expiring 1970—W. H. Rankin, senior structural engineer, St. Louis—San Francisco, Springfield, Mo.; E. E. Runde, chief masonry inspector, Illinois Central, Chicago, Ill.; A. C. Jones, process engineer—structures, Southern, Atlanta, Ga.

NEW COMMITTEE SUBJECTS

In addition to the two standing committee subjects, four special subjects have been selected and committees appointed to report at the 73rd annual convention to be held September 8–11, 1968 at the Hilton Hotel in Chicago, Ill.

The special assignments are:

1. Latest Developments of "In Place" Treatment of Timber Bridges.
2. Ways and Means of Repairing and Replacing Expansion Rollers under Bridges.
3. Procedure for Replacing Timber Trestles with Steel and Concrete Structures.
4. Centralized Bridge and Building Assignments vs. Floating Gangs.

TREASURER'S REPORT

SEPTEMBER 1, 1966 TO AUGUST 31, 1967

Balance—August 31, 1966			$2,503.30
RECEIPTS:			
Dues—1968	$ 14.00		
Dues—1967	3,221.00		
Dues—Prior	147.00	$3,382.00	
Advertising:			
1965 Proceedings	$2,172.00		
1966 Proceedings	210.00	2,382.00	
Sale of Proceedings		5.00	
Membership Certificate		1.00	5,770.00
Total			$8,273.30
DISBURSEMENTS:			
Salaries (Secretary and Assistant)		$2,018.22	
Withholding (Social Security and Income Tax)		549.69	
Stationery and Printing		489.82	
Postage		659.12	
Office Rent and Telephone		289.26	
1965 Proceedings		1,762.73	
Convention Expense (1966)		345.62	
Office Supplies		63.89	
Membership Certificates		2.00	
Addressograph		2.72	
Surety Bonds		26.00	
Miscellaneous		3.88	$6,212.95
Balance—August 31, 1967			$2,060.35
Cash on hand First National Bank of Chicago, August 31, 1967			$2,060.35

W. H. HUFFMAN, *Treasurer*

September 11, 1967

APPROVED:
E. R. Schlaf, *Chairman*
W. A. Buckmaster
H. D. Curie

SECRETARY'S REPORT

ANNUAL REPORT OF MEMBERSHIP FOR PERIOD SEPTEMBER 24, 1966 TO SEPTEMBER 30, 1967

ACTIVE MEMBERSHIP:			
Total Active Members, September 24, 1966		581	
New Active Members since September 24, 1966		80	
		661	
LESS—Resigned Account Retirement, etc.	21		
Members Reported Deceased	4		
Transferred to Life Membership	10		
Transferred from Active to Associate	1		
Dropped for Non-Payment of Dues	37	73	
TOTAL ACTIVE MEMBERS—SEPTEMBER 30, 1967			588
ASSOCIATE MEMBERS:			
Total Associate Members, September 24, 1966		92	
New Associate Members since September 24, 1966		6	
Transferred from Active to Associate		1	
		99	
LESS—Resigned Account Retirement, Etc.	6		
Dropped for Non-Payment of Dues	11	17	
TOTAL ASSOCIATE MEMBERS—SEPTEMBER 30, 1967			82
LIFE MEMBERS:			
Total Life Members, September 24, 1966		121	
Transferred from Active Membership		10	
		131	
LESS—Reported Deceased		9	
TOTAL LIFE MEMBERS—SEPTEMBER 30, 1967			122
HONORARY MEMBERS:			
Total Honorary Members, September 24, 1966		6	
Honorary Member Added September 26, 1966		1	
TOTAL HONORARY MEMBERS—SEPTEMBER 30, 1967			7
TOTAL MEMBERSHIP—ALL CLASSES—SEPTEMBER 30, 1967			799

REPORT OF AUDITING COMMITTEE

TO MEMBERS OF THE
AMERICAN RAILWAY BRIDGE & BUILDING ASSOCIATION:

Gentlemen:

The undersigned have examined the books of the Secretary and report of the Treasurer for the period from September 1, 1966, to August 31, 1967, inclusive, and have found them to be correct as of the latter date.

Respectfully submitted,

E. R. Schlaf, *Chairman*
W. A. Buckmaster
H. D. Curie

September 11, 1967

The President's Report

By R. D. HELLWEG

Asst. Reg. Engr., Gulf, Mobile & Ohio

Good morning, Ladies and Gentlemen—I now call for order so we may open our convention. As President of the American Railway Bridge & Building Association and on behalf of Mr. W. C. "Mac" McCormick, President of the Roadmasters and Maintenance of Way Association of America, I hereby declare that the 72nd Annual Convention of the former Association and the 79th Annual Convention of the latter are now open in joint session. We welcome you to Chicago for this 22nd consecutive Annual Joint Session of our associations. We anticipate with confidence that your visit to Chicago will be a profitable one both for you and your company. Also, we hope it will be a pleasant one.

This convention has been planned for your benefit and that of the railroad you represent. Rather than take valuable time from various reports to give you a full schedule here, I wish to refer you to your program which details the various presentations and their scheduling. You have our promise that we will attempt to keep our entire convention on time so you will not miss anything.

Under Rule 6 of the By-Laws of this Association it is my duty to report on the general condition of your Association.

I am pleased to be able to tell you that I am thankful for the privilege of presiding over your Association's Seventy-Second Convention. In looking over the records of our organization I discovered that 29 years ago my railroad was represented by Mr. Armstrong Chinn who served as your President during the 1938–39 term. Mr. Chinn, at the time, was Chief Engineer of the former Alton Railroad which now is a part of the present-day Gulf, Mobile & Ohio Railroad System.

Since 1939 your Association has had some ups and downs but right now we are in a sound financial position. We do not have a big bank account but we are operating within our income. This is something we did not do a few years past, as can be seen by the following comparison:

On Aug. 31, 1963 our balance was $647.08; on Aug. 31, 1964 our balance was $1,090.08; on Aug. 31, 1965 our balance was $2,114.36; on Aug. 31, 1966 our balance was $2,503.30, and on June 30, 1967 our balance was $2,661.22.

Thus you see a gain of $2,014.14 from 1963 to 1967 and we have not as yet received monies for advertising in our 1966 proceedings. One of the things that helps more than anything else to keep us solvent is the advertising which is sold to go into our annual proceedings. Each of you can help this organization if you will tip off our secretary to any likely prospects for advertising. Your help along these lines is solicited.

Membership-wise your organization is holding its own. Especially in view of the fact that most of our railroads across the continent do not have as many people working in a capacity that makes them eligible for membership in our organization. In 1963 our total membership was 887; in 1964 our total membership was 860; in 1965 our total membership was 829; in 1966 our total membership was 800; in 1967 our total membership is 822.

From this you can see that our membership has stabilized. With your individual help it can grow. I want to give particular thanks to the Membership Committee for their superb efforts in maintaining our membership. This is a never ending task which will face your officers in the future. Percentage-wise, we probably actually have an increase in membership—when a comparison is made to the number of railroad or railroad oriented men who are actually available for membership.

Again this year, as in the past, your association has enjoyed wonderful relations with the Railway Engineering—Maintenance Suppliers Association, and an end result of this splendid cooperation is the banquet which they are giving to all of us tomorrow night at the Sherman Hotel. Their continued assistance to this organization is appreciated and your telling their members of your appreciation of their efforts will enhance our future contacts with that organization. Again REMSA gets my vote of confidence.

The Convention Program Committee, in conjunction with the Standing and Special

Subjects Committees, has assembled quite a bit of interesting material for this convention. Feel free to enter into the discussions following our reports. Sometimes we learn more in these off-the-record sessions than we do in a year's work. Let us hear your ideas—they will be most welcome.

Your Hotel Arrangements Committee is already well along in its planning for next year's convention and I wish to express my gratitude to Bob Dove and his Committee for the good job they have done this past year.

This year we will have our first full report from our Standing Committees and we all look forward to the continuation of their work for years to come. The Special Subjects Committee has been working to line up four good subjects for next year and I look forward to 1968 being a great year for the American Railway Bridge & Building Association.

Again I want to call your attention to the activities that have been planned for the ladies this year. We hope they will have a good time while you are working here.

Your company either sent you or allowed you to attend this convention. This convention can be to you the same as if you were attending a management seminar, or a group training class which might be set up to give opportunities for personal improvement. You will hear some mighty good reports the next few days. You will have the opportunity to enter discussions on the floor as to questionable points, or to develop and present your own thinking in areas which you desire to question. This makes our convention. You will not be restricted, unless something comes up which is unforeseen at this time. We beg you to participate and give to all the benefit of the many years of experience which are gathered together here. All of the reports to be presented will be reproduced in the proceedings which we hope to get to you earlier next year than was possible this year.

I humbly thank you for giving me the honor of representing you as your President for the past year. Also I want to praise and thank the other officers and the directors of the association. Without their able help the work of the past year could not have been done.

Don't overlook volunteering for committee work next year and please participate actively. This will be a big help to your next President. This also is the life blood of this group. I am not a politician blessed with a flowing gift of gab so I will cut this talk short in favor of some fine reports we have coming up later. We are bound to run late this afternoon so let's get the show on the road. Thanks to all of you.

Weathering Steel

Subcommittee Report

J. R. IWINSKI, CHAIRMAN

Assistant Engineer Bridges, C. B. & Q.

Dating from sometime in the middle of the 19th century metals have played an increasingly important part in the construction of bridges and buildings.

At first, the primitive methods of reducing the basic ores produced cast iron, which was used only at certain locations. As production processes improved, wrought iron was developed as a structural material, and was rather widely used until the late 1800's when it also fell to technological advances and was replaced by steel as a major construction material.

Steel has thus endured for a period of almost 80 years with relatively few changes to it's basic character.

In the recent past, major producers of structural steel have been developing a large variety of specialty steels that are gaining more and more acceptance as structural materials.

As a part of the report a film was shown, with the cooperation of Mr. Wilfred C. Turner of United States Steel Co., describing in a general way the variety of different steels that are now available.

On the many steels described, the weathering steel that produces it's own protective coating would appear to be the type that would be most widely used and provide immediate benefits from it's usage. It has been quite extensively used in buildings and is gaining in use for bridges, both highway and railroad.

Mr. Al Hoffman of Bethlehem Steel made a slide presentation showing the characteristics and desirable qualities of this material.

Highlights of AAR Structural Research

Prepared by
E. J. Ruble
Executive Research Engineer

Freeman P. Drew
Research Engineer Structures

Association of American Railroads

E. J. Ruble

The word "structures or bridges" is really a most personal one in several respects. Possibly this week there may be those among you who will visit your doctor upon your return home from this convention in the hope that he may assure you that the "bridge" of your nose has not been irreparably damaged by Junior, who, after he put on the pair of boxing gloves you took home to him, proceeded to plant a devastating haymaker on your proboscis; or some of you may visit your dentist who will break the sad news that the upper bridge has broken and two weeks salary must go for repairs. Upon further thought, I do not believe your program committee wanted me to discuss bridges in such a personal manner so I will hold my comments to research on structures of steel, timber or concrete, built to carry a train across a river, highway, canyon, et cetera.

Today we have electronic computers to calculate the stresses and make the detailed drawings with mechanized equipment to fabricate and erect the structures so bridge building today is truly a science. Research plays a very important part in the building of our structures today and actually I believe it has always played an important part. Undoubtedly, the Greeks determined the carrying capacity of the stone lintels used in the construction of their temples built 500 years before the birth of Christ. The Romans built many bridges and aqueducts that are still in use today after 2,000 years and surely they did some experimental work to determine the relation between the imposed loads, length of span and shape of the structure.

In general, there are three important milestones in bridge construction, the first being the building of the bridge over the Euphrates River in Babylon in 783 BC and described by Herodotus, the "father of history" in 484 BC. The bridge was 660' ft. long with stone piers connected with wooden platforms which were removed at night to prevent thieves from entering the city. The second milestone was in March 1638 in Leyden, Holland with the introduction of the world's first book on the Strength of Materials. The book was written by Galileo, based on experiments made some forty years earlier. You remember Galileo as not only a physicist but also as a great astronomer and the inventor of the telescope. The third milestone was the development of the exact computation of stresses in bridges by Squire Whipple in 1847 and by Herman Haupt in 1851. The work of these two engineers forms the foundation of the modern theory of framed structures.

The first known research on the dynamic effects of moving loads over structures are to be found in the 1849 "Report of the Commissioner appointed to inquire into the Application of Iron to Railway Structures" and this report is based on the testimony of the most important civil engineers of the day. This English Parliamentary Commission conducted experiments and sponsored a theoretical study of the subject. While the Commission did not publish specifications, its report did have a pronounced influence on English and American specification writers for several years. Considering this fact, we are safe in saying that impact specifications supported by research were born in 1849.

In 1885, Professor S. W. Robinson, in his report to the Railroad and Telegraph Commissioners of Ohio, made a clear statement as to the various forces producing impact. Part of Professor Robinson's report dealt with the vibration of bridges. He not only recognized the effect of synchronous speed, but gave equations for computing the natural loaded frequencies of bridges.

The most complete research program conducted on structures heretofore in this country were made by the Committee on Impact of the American Railway Engineering and Maintenance of Way Association under the direction of F. E. Turneaure, Dean of College of Engineering, University of Wisconsin. The results of these tests were published in 1911 and gave ample evidence of the effect of synchronous speed and the effect of locomotive counterbalancing. In addition to the test data, the report contains an interesting discussion on the theory of oscillations and span frequencies. Impact values, based on the data presented by Prof. Turneaure, were used in the design of railroad bridges until 1935.

In order to secure more data on the damping coefficients in bridges of this country, the late Mr. J. B. Hunley, Engineer of Bridges and Structures of the Big Four Railroad secured static and dynamic deflection readings on 39 different railroad spans under about 300 different locomotives. The report of these tests was published by the AREA in 1935 and a very thorough resumé of the general theory of vibrations, as developed by Prof. S. Timoshenko, Prof. C. E. Inglis, and others, is included. The report contains detailed results of the tests and also includes the dynamic magnifiers and damping coefficients obtained under the different classes of locomotives. The AREA design specifications for railroad bridges were revised in accordance with the recommendation for impact effects and was used until 1948.

In revising the design specification for impact in 1935, the bridge engineers realized that the entire subject of impact should be again studied on account of the increasing speeds and weights of the locomotives as well as the entrance of the high speed diesel locomotives having relatively small wheels. They also realized that all previous specifications were based either on deflections or on mechanical instruments subject to considerable error due to vibrations. For these reasons they recommended that a Special AREA Committee on Impact be organized and funds be requested from the Association of American Railroads for the purchase of electrical recording instruments and the conduct of the research. The bridge engineers realized that the railroads have a total of 1800 miles of steel bridges, 1800 miles of timber bridges and 900 miles of concrete bridges and their recommendation included research on all three types of structures.

SHORT SPANS

There are approximately 36,000 short span steel bridges varying in length from 20 ft to 40 ft and since the dynamic effects in the short spans are usually greater than that in the longer spans, our decision was to start our research on this type of span. After purchasing the necessary electronic equipment, research was started on the short spans in 1941. The investigation included research on six short spans and the strains or stresses were determined under 900 diesel and steam locomotives crossing over these structures at speeds varying from 5 mph up to 85 mph for the steam locomotives and 100 mph for the diesels.

The maximum total impact percentages, based on the recorded static stresses, produced in the short spans by the passage of the steam locomotives we call a "shot gun pattern". The total impact values are the increase in strain over that produced by a slowly moving locomotive and results from several effects, such as; hammer blow, rolling of the locomotive about a longitudinal axis, vertical accelerations of the sprung weight and uneven tie support. In general, there is a gradual increase in the magnitude of the total impact with an increase in speed up to about 40 mph.

The impacts produced in the short spans by the diesel locomotives also produces a gradual increase in the magnitude of the total impact up to about 40 mph. In general, the maximum impacts produced by the steam locomotives were 76 percent as compared with a maximum of only 48 percent for the diesel locomotives. This recorded impact value under the steam locomotives was considerably below the former design allowance of 108 percent for the same length span.

GIRDER SPANS

With the completion of the investigation of the stresses and impacts in short span bridges, the AAR staff began its research on girder spans. This work was very comprehensive and included test data on thirty-seven girder spans varying in length from 40 ft to 140 ft. The strains or stresses were determined under the passage of about 3200 diesel and steam locomotives.

As a result of this particular research, AREA Committee 15, Iron and Steel Structures revised their Specification for impact allowance taking advantage of the lower values resulting in considerable saving to the railroad industry.

IMPACT IN STEEL TRUSS SPANS

The above indicates that a great deal of research has been performed to obtain impact data on short beam spans and girder spans. Currently efforts are being directed toward development of impact data on steel truss spans. It is not expected that the same number of field tests on truss spans can be made as were conducted on girder spans; however, sufficient work will be conducted to provide data by which a recommendation can be made for either revising or confirming the present impact equation for steel truss spans.

One of the recent field tests conducted in this area was on the Southern Pacific Company bridge near Del Rio, Texas where a 300 ft and a 400 ft span was instrumented. This bridge was selected because of its relatively new design and recent construction and because the speed of regular freights across the bridge was sufficiently high for our purpose. The total program for field tests on truss spans will include various types of trusses, various span lengths and both open deck and ballasted deck construction.

During our early research, the steam locomotive was the predominant live load on railroad bridges and the recorded stresses reflected the influence of these locomotives. In recent years, however, the car has become the predominant live load and it has been necessary to obtain field data on the behavior of structures under car loadings.

During the time that steam locomotives were being operated, it was determined that only about ten percent of the total stress occurrences produced a near maximum stress in a bridge element. Today with the increased use of heavily loaded cars, the frequency of occurrence of maximum stress has not changed measurably, and in fact, is more on the order of five percent. While car loads today produce many more cycles of stress, the vast majority of these cycles are of low amplitude and are not significant from a fatigue standpoint. It had been thought that with unit train operation where the consist is generally uniform, that the frequency of occurrence of maximum stress might be rather high. To obtain such data a bridge in the Chicago area was instrumented and stress recordings obtained under unit trains as well as all other trains in service on that line. These were taken night and day for a one week period. It was found that in spite of the unit train operation that the frequency of occurrence of maximum stress is still very low. It must be kept in mind that even if a bridge carried only unit trains, the cars must return empty so 50 percent of the stresses will be from these light loads.

CORROSION

Another aspect of research in the area of steel bridges has been on the corrosion resistance of various metals to salt brine exposure.

In 1958 a series of test plates were installed on the deck of the Huey Long Bridge in New Orleans. The various metals used in this study were those which could be used to form the metal trough on ballast deck bridges. The various metals studied in this exposure included the common structural steels, A7 (with and without copper), A242, a steel advertised as having high corrosion resistance, A373, a steel for welding, stainless steel, two types of aluminum and others. After five years exposure it was found that all of the plates except the stainless steel and one type aluminum had approximately the same amount of weight loss due to this exposure. Next year another set of these plates will be removed for determining weight loss after 10 years exposure and similarly at the end of a 15 year period. There is some doubt, however, that some of the plates will be little more than a pile of rust at the end of the 15 year period.

EPOXY RESIN COATINGS

The Huey Long Bridge has also been used as a proving ground for various protective coatings on steel. Several series of test plates were installed in 1962 to demonstrate the resistance of epoxy resin coatings to the salt brine exposure at this location. In 1966 all of the plates showed advanced coating breakdown as shown by the right-hand plate and were removed. Even though these epoxy coatings did not prove to be particularly resistant to this exposure, a zinc-rich epoxy coating became available in 1965 and test plates were installed at that time. This is a cathodic type coating and at last inspection showed no evidence of rusting, blistering or other coating failure and appears to be very effective in this salt brine exposure.

IMPACT IN PRESTRESSED CONCRETE SPANS

Concrete bridges also have received their share of research activity and in recent years we have concentrated on prestressed concrete bridges. Since the first prestressed concrete railroad bridge was installed on the Burlington Railroad in 1954, it was apparent that the impact recommendation for design of prestressed spans needed revision and as bridges became available for field investigational work, they were studied for their dynamic response to live loads. To date, impact data has been obtained on nine spans varying in lengths from about 18 ft to nearly 70 ft. It is hoped that after additional spans have been tested, particularly in the 50 to 60 ft range, that a recommendation can be made for revising the design impact equation. AREA Committee 30 has already made a tentative recommendation for impact of $35 - \frac{L^2}{500}$ and some railroads are using this. Present data indicates this to be reasonable.

PRESTRESSED CONCRETE BOX BEAMS

For use as a railroad bridge, the rectangular box beam has come into widespread use. It has certain advantages, one of which is that immediately after installation, the track and ballast can be placed resulting in a minimum of interruption to traffic. AREA Committee 8, Masonry, prepared a specification for use of box beams on trestle construction and to demonstrate the suitability of this type construction, the Research Center conducted a laboratory investigation to determine the static and repeated load strength of such beams. These studies indicate that the box beam is well suited for railroad loading, and can sustain static ultimate moments about three times the design moment and 2,000,000 cycles of load nearly two times design. Specifications of recommended practice using box beams now appear in the AREA Manual.

The laboratory studies included the conventional type box beam which has end blocks and a center diaphragm and also a newly conceived type of box beam known as a through-voided beam. This type of beam has no end blocks or diaphragms and has the obvious advantage of direct access to the inner portion of the section for inspection purposes.

The laboratory studies also included box beams cast with light weight aggregates and these were found to be satisfactory also.

SHEAR KEYS

Box beams may be constructed either singly or in pairs and when used to form a span are mounted side by side on the bridge bearings. Keyways are thereby formed between the sections which can be filled with various types of materials to effect the necessary shear transfer and create a monolithic deck. One of the materials developed at the Research Center for use in shear keys is an epoxy resin-sand mixture. This material has the advantage of fast set time and good bond to the concrete surfaces. Other shear key materials can also be used such as Portland cement mortar and certain proprietary non-shrink mortars. If mortars are used for shear keys, laboratory studies at the Research Center have shown that it is necessary to use transverse tie rods between the box beams, whereas by use of an epoxy resin mixture, these tie rods are not considered necessary.

HIGH SPEED IMPACT

Currently under study at the Research Center is a project to determine the effect of high speed impact stresses on concrete. It has long been thought that concrete was able to withstand higher stresses when rapidly applied and this is being demonstrated at the Research Center. Battered rail joints on bridges result in such high speed impacts and this type of condition is being duplicated in the laboratory. True impacts produce stress increases in 0.005 sec whereas ordinary dynamic stress increases may occur in only 0.5 sec. A short prestressed concrete beam has been installed in a rolling load machine and permits repeated applications of high speed impacts of various amplitudes. It has been interesting to note that identical concrete beams stressed to the same level will carry more cycles of load under high speed impact than under normal speed stress applications.

STRESSES IN TIMBER STRINGERS

Timber as a bridge material is equally as important as steel and concrete and has its place in the construction picture. It is necessary, therefore, that research on timber keep pace with other materials in order that timber can be utilized to its greatest advantage.

In 1961 a large scale research program on full size timber trestle stringers was started at the Research Center. This research involved the static and fatigue strength of solid-sawn and glued-laminated members of fir and pine specie. Very little laboratory work had been performed in the past on full size specimens and also very little work had been conducted on the repeated load strength of such specimens.

One of the interesting aspects of this research has been that under static loading the predominant type failure has been flexure whereas under repeated loading the predominant failure has been in horizontal shear. It has also been demonstrated that for moving loads the critical position for shear is not when the load is close to the support, but rather when it is away from the support a distance of about three stringer depths.

The results of these investigations have indicated the fatigue strength of the various type specimens at 2,000,000 cycles of loading. The shear values obtained have all been in excess of the recommended allowable working stresses and, therefore, represent the margin necessary to provide for the effects of impact, treatment and factor of safety.

GLUED LAMINATED BEAMS

Glued laminated bridges were introduced to the American Railroads in 1944 when a panel of glu-lam stringers was installed in a trestle of the Texas & Pacific Railroad. Since then other glu-lam trestles have been built as well as some very long span glu-lam bridges. A recent inspection of the various test installations was made and after 20 years of use this type construction has shown an excellent performance. The absence of checks and glue line separations have been most apparent as can be observed in the cap of this trestle.

Glued-laminated stringers for trestle construction will cost more than solid-sawn stringers, but for longer span bridges such as 60 ft, the cost picture is different. For these length spans solid-sawn members, of course, are out of the question and a choice must be made between glulam and other materials, such as steel or concrete. Estimates indicate that the cost of a 60 ft glued-laminated span may be slightly less than a similar length steel span.

The flexural behavior of large glued laminated beams was recently demonstrated at the Research Center when several 50 ft long specimens were load tested to their ultimate capacity. These beams were 9 in wide and 31½ in deep, and each contained 21—1½ in thick Douglas fir laminations. An ultimate flexural stress of 8,400 psi was developed during this test and the total center line deflection was nearly 12 in before failure.

NON-DESTRUCTIVE TESTING

One of the important aspects of timber trestle maintenance is the need for an adequate inspection technique for the determination of internal decay. Studies have been conducted at the Research Center to demonstrate the suitability of certain proprietary devices to detect internal decay in large structural timbers such as stringers, caps and piling using non-destructive techniques. A device using a nuclear source was developed and demonstrated at the Research Center and while it worked well on dry wood it was sensitive to wet wood and was not considered satisfactory for general use. More recently devices have become available utilizing sound waves and these are not effected by moisture in the wood. A recent demonstration at the Research Center has indicated that these sonic devices can detect internal voids and may be a useful tool for the bridge inspection.

TERMITES AND DECAY

In 1965, about 2,000 treated and untreated oak, pine and fir stakes were installed near Gainesville, Florida to determine the most effective preservative with the minimum retention to reduce decay and termite attack. A total of thirteen different preservatives and three different retentions were used.

These specimens have been inspected periodically and after nearly 10 years of exposure the specimens treated with coat tar creosote show less decay and termite attack than those treated with other preservatives. In general, the fir specimens treated with most of the preservatives are subjected to less decay and termite attack than the oak or pine.

LONGITUDINAL FORCES ON BRIDGES

As indicated earlier a large part of our field investigational work has been the obtaining of impact data on bridges. During most of these field tests we have been able to obtain limited data on the effect on the structure of trains braking to a stop on the bridge and accelerating off the bridge. From the earliest such test, it was apparent that a large portion of the total longitudinal force generated was transferred directly to the embankments at each end of the bridge through the rails and only a small portion went into the structure. Recently a field test was conducted specifically to obtain data on longitudinal forces. A 660 ft long concrete trestle on the Santa Fe was instrumented and by use of a work train braking and traction forces were developed and the distribution of these forces to the rails and the supporting structure was measured. Here also it was found that for a bridge of this type contained between two embankments, and with the rails continuous across the embankments and the bridge, that the structure was subjected to less longitudinal force than is now recommended in the AREA Specifications.

AREA Committee 15 in preparing its revised specification for Steel Railway Bridges has taken advantage of our research data and has reduced the recommended longitudinal force considerably. The resulting recommendation, while still tentative, is considered to be more realistic, and more in line with forces as they actually exist.

BUTYL RUBBER MEMBRANES

Waterproofing a steel, timber or concrete deck has long been a problem in both maintenance of existing structures and constructing new ones. Membranes built up of several plys of asphaltic fabrics often leak after short service life and the need for a better system has been indicated. Recently the introduction of butyl rubber as a deck waterproofing material has been found to be effective in producing an easily applied and waterproof deck. This material arrives at the bridge site rolled in a continuous sheet to cover the entire width and length of the bridge deck. For most applications, no field splices are necessary and once rolled out on the deck and covered with a protective course of asphalt plank material, it is ready for traffic. Many bridges have been constructed using this material and the service records to date have been very good. Sheets of neoprene are also available.

A laboratory study is now underway at the Research Center to demonstrate the need for a protective cover on this type membrane. A test setup consisting of a bin 7 in by 5 ft by 15 in deep has been constructed, into which the butyl rubber, the protective course, slag ballast and track ties will be placed. The entire assembly will be loaded repeatedly to simulate service conditions to demonstrate the performance of this type of waterproofing system.

ELECTRONIC CALCULATIONS

The electronic computer has played an important role in simplifying railroad bridge design procedures and the Research Center published the now familiar Green Book giving moments, shears and floor beam reactions of special type loadings on spans up to 400 ft. This book was made possible only by the use of a computer program and the laborious method of computing moments and shears for special loads has now been reduced to less than a minute of computer time and results in a cost per table of $10 to $15. Recently a computer program was written to determine the stresses in railway truss bridges. While this program is much more involved than the moment and shear program, it nevertheless greatly simplifies calculation of stresses in this type structure. For about two minutes of computer running time and a cost of $20 to $25 a truss span of 10 panels can be processed at a fraction of the time necessary to do the same operation longhand.

Both of the above computer programs have been well advertised as to their availability and I am sure that all of you here are aware that they are available, many have taken advantage of them and are using them.

In conclusion, we feel that the Research Center has made a definite contribution to the science of railroad bridges but we all know there is far more in building a bridge than just research, for there must be planners, designers, fabricators, iron workers, maintenance crews and men of finance to make possible the track and structures.

It is not given to all of us to be planners or research engineers. However, we all do meet one common ground as bridge builders, for regardless of our profession in life, we can attain happiness and success as builders of bridges of loyalty and of character.

REPORT OF RESOLUTIONS COMMITTEE

As a token of appreciation for the time and effort certain individuals and organizations have contributed to make this, the 72nd Convention in the 76th year of the A.R.B. & B.A., an outstanding success the committee on resolutions presents the following report:

BE IT RESOLVED that the sincere thanks of the Association be extended to the

Reverend Dr. Kenneth Hildebrand, Pastor, Central Church, Chicago, Ill., who was so kind to come among us and invoke the divine blessing and guidance on the combined activities of this Association, the Roadmasters & Maintenance of Way Association of America, the Railway Engineering–Maintenance Suppliers Association and guests.

BE IT FURTHER RESOLVED that the thanks of the Association be extended to Mr. W. C. McCormick, President, Roadmasters and Maintenance of Way Association of America; Mr. R. D. Hellweg, President, American Railway Bridge and Building Association; Mr. T. B. Hutcheson, President, American Railway Engineering Association; Mr. H. R. Miller, President, Railway Engineering–Maintenance Suppliers Association and Mr. George W. Christianson, First Vice President, Railway Engineering–Maintenance Suppliers Association who greeted us with such kind and warm remarks of welcome.

BE IT FURTHER RESOLVED that the thanks of the Association be extended to Mr. T. T. Martin, Vice President, Industrial Development, Gulf, Mobile & Ohio Railroad; Mr. R. R. Manion, Vice President, Operations and Maintenance Department, Association of American Railroads; Mr. T. B. Hutcheson, Assistant Vice President Engineering and Maintenance of Way, Seaboard Coast Line; Mr. L. W. Menk, President and Chief Administrative Officer, Northern Pacific and Mr. E. J. Ward, Director of High Speed Ground Transportation, Department of Transportation, Federal Railroad Administration, for their inspiring remarks and council in addressing the joint sessions.

BE IT FURTHER RESOLVED that the thanks of the Association be extended to Mr. E. J. Ruble, Executive Research Engineer, AAR and Mr. J. B. Clark, Chief Engineer, Louisville & Nashville Railroad, for their illustrated addresses.

Be it further resolved that the thanks of the Association be extended to the Chairman and members of each committee presenting reports which contributed so materially to the success of this convention.

BE IT FURTHER RESOLVED that the thanks of this Association be extended to Mr. C. J. Miller, President, and Mr. G. W. Christiansen, First Vice President, Railway Engineering–Maintenance Suppliers Association and to all members of that Association for their support throughout the year, for the splendid banquet and generous hospitality shown us during this convention.

BE IT FURTHER RESOLVED that the thanks of the Association be extended to Mrs. W. C. McCormick and Mrs. R. D. Hellweg, also their committee for the efficient handling of the ladies registration and reception.

BE IT FURTHER RESOLVED that the thanks of the Association be extended to the managements and staffs of the LaSalle Hotel and the Sherman Hotel for the many courtesies shown during this convention.

BE IT FURTHER RESOLVED that the thanks of the Association be extended to the Simmons–Boardman Publishing Corporation and its representatives for their valuable and excellent coverage of the Association activities.

BE IT FURTHER RESOLVED that the thanks of the Association be extended to Mrs. Lillian Dick, Mrs. Pat Theis, Beatrice Orne, Gertrude Armstrong, Sandra Fuller and Nancy Gaffney for their able assistance with registration and other clerical matters at the desk during this convention.

AND FINALLY BE IT FURTHER RESOLVED that our most sincere thanks and application be extended to Mr. R. D. Hellweg, our retiring president, who so ably and effectively directed the Association's activities during the past year.

Respectfully submitted,
W. L. SHORT, *Chairman*

REPORT OF NECROLOGY COMMITTEE

1966–1967

To the President and Members of the

AMERICAN RAILWAY BRIDGE & BUILDING ASSOCIATION

We regret to advise we have learned of the loss of thirteen (13) members through death during the year. It is possible that other members have passed away during the year of whom we have no information. If you know of any, we would like to have their names to include in the list to be printed in the Annual Proceedings.

The following have been reported since our last Annual Meeting in September, 1966:

ACTIVE MEMBERS	TITLE—RAILROAD	YEAR JOINED	DATE DECEASED
C. J. Code	Assistant Chief Engineer—Staff Pennsylvania Devon, Pa.	1961	Dec. 1966
C. E. McKenney	System Scale Inspector Norfolk & Western Ft. Wayne, Ind.	1956	Dec. 1966
A. P. Milne	Supervisor Bridge & Building Norfolk & Western Frankfort, Ind.	1953	Aug. 1967
B. J. Ornburn	Assistant Chief Engineer—Structures Chicago, Milwaukee, St. Paul & Pacific Chicago, Ill.	1948	1967
LIFE MEMBERS			
H. L. Barr (ret.)	Division Engineer Chicago and North Western Chadron, Nebr.	1938	1966
H. M. Church (ret.) (President 1940–41)	General Supervisor Bridge & Building Chesapeake & Ohio Richmond, Va.	1939	Oct. 1966
F. E. Gladwin (ret.)	Bridge & Building Supervisor Northwestern Pacific San Rafael, Calif.	1950	Oct. 1966
A. M. Glander (ret.)	Chief Carpenter Chicago, Milwaukee, St. Paul & Pacific Austin, Minn.	1936	1964
H. Heiszanbuttel (ret.)	Bridge & Building Supervisor Chicago & North Western Norfolk, Nebr.	1917	1966
D. A. Manning (ret.)	Supervisor Bridge & Building Chicago and North Western Brookfield, Ill.	1939	1963
P. B. Merwin (ret.)	Assistant Engineer Chicago and North Western Portland, Ore.	1929	1967
A. B. Nies (ret.)	Architect Michigan, Central Jackson, Mich.	1915	Mar. 1967
W. J. O'Brien (ret.)	District Carpenter Chicago, Milwaukee, St. Paul & Pacific Necedah, Wis.	1919	1967

We deeply regret the passing of these, our fellow members. May we stand a moment in silence to honor these departed members.

Respectfully submitted,
C. E. Wachter, *Chairman*

HISTORICAL INFORMATION

List of Annual Conventions

No.	Place of Meeting	Date	Membership
1	St. Louis, Mo.	Sept. 25, 1891	60
2	Cincinnati, Ohio	Oct. 18–19, 1892	112

No.	Place of Meeting	Date	Membership
3	Philadelphia, Pa.	Oct. 17–19, 1893	128
4	Kansas City, Mo.	Oct. 16–18, 1894	115
5	New Orleans, La	Oct. 15–16, 1895	122
6	Chicago, Ill.	Oct. 20–22, 1896	140
7	Denver, Colo.	Oct. 19–21, 1897	127
8	Richmond, Va.	Oct. 18–19, 1898	148
9	Detroit, Mich.	Oct. 17–19, 1899	148
10	St. Louis, Mo.	Oct. 16–18, 1900	143
11	Atlanta, Ga.	Oct. 15–17, 1901	171
12	Minneapolis, Minn.	Oct. 21–23, 1902	195
13	Quebec, Canada	Oct. 20–22, 1903	223
14	Chicago, Ill.	Oct. 18–20, 1904	293
15	Pittsburgh, Pa.	Oct. 17–19, 1905	313
16	Boston, Mass.	Oct. 16–18, 1906	340
17	Milwaukee, Wis.	Oct. 15–17, 1907	341
18	Washington, D. C.	Oct. 20–22, 1908	368
19	Jacksonville, Fla.	Oct. 19–21, 1909	393
20	Denver, Colo.	Oct. 18–20, 1910	428
21	St. Louis, Mo.	Oct. 17–19, 1911	499
22	Baltimore, Md.	Oct. 15–17, 1912	524
23	Montreal, Quebec	Oct. 21–23, 1913	570
24	Los Angeles, Cal.	Oct. 20–22, 1914	586
25	Detroit, Mich.	Oct. 19–21, 1915	665
26	New Orleans, La.	Oct. 17–19, 1916	710
27	Chicago, Ill.	Oct. 16–18, 1917	704
28	Chicago, Ill.	Oct. 15–17, 1918	716
29	Cleveland, Ohio	Oct. 21–23, 1919	776
30	Atlanta, Ga.	Oct. 26–28, 1920	840
31	New York, N. Y.	Oct. 18–20, 1921	850
32	Cincinnati, Ohio	Oct. 17–19, 1922	865
33	Seattle, Wash.	Oct. 16–18, 1923	846
34	Kansas City, Mo.	Oct. 21–23, 1924	837
35	Buffalo, N. Y.	Oct. 20–22, 1925	759
36	Richmond, Va.	Oct. 12–14, 1926	750
37	Minneapolis, Minn.	Oct. 18–20, 1927	754
38	Boston, Mass.	Oct. 23–25, 1928	755
39	New Orleans, La.	Oct. 15–17, 1929	755
40	Louisville, Ky.	Oct. 21–23, 1930	713
41	Chicago, Ill.	Oct. 16–18, 1934	592
42	Chicago, Ill.	Oct. 15–17, 1935	547
43	Chicago, Ill.	Oct. 20–22, 1936	588
44	Chicago, Ill.	Oct. 19–21, 1937	566
45	Chicago, Ill.	Oct. 18–20, 1938	589
46	Chicago, Ill.	Oct. 17–19, 1939	546
47	Chicago, Ill.	Oct. 15–17, 1940	610
48	Chicago, Ill.	Oct. 14–16, 1941	594
49	Chicago, Ill.	Oct. 20–22, 1942	618
50	Chicago, Ill.	Oct. 20–21, 1943	597
51	Chicago, Ill.	Sept. 17–19, 1946	698
52	Chicago, Ill.	Sept. 16–18, 1947	651
53	Chicago, Ill.	Sept. 20–22, 1948	652
54	Chicago, Ill.	Sept. 12–14, 1949	676
55	Chicago, Ill.	Sept. 18–20, 1950	713
56	Chicago, Ill.	Sept. 17–19, 1951	676
57	Chicago, Ill.	Sept. 15–17, 1952	667
58	Chicago, Ill.	Sept. 15–17, 1953	666
59	Chicago, Ill.	Sept. 13–15, 1954	682
60	Chicago, Ill.	Sept. 19–21, 1955	625
61	Chicago, Ill.	Sept. 18–20, 1956	657
62	Chicago, Ill.	Sept. 23–25, 1957	769
63	Chicago, Ill.	Sept. 15–17, 1958	828
64	Chicago, Ill.	Sept. 15–17, 1959	863
65	Chicago, Ill.	Sept. 19–21, 1960	932
66	Chicago, Ill.	Sept. 18–20, 1961	968
67	Chicago, Ill.	Sept. 10–12, 1962	942

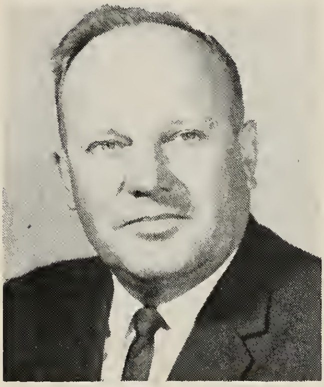
No.	Place of Meeting	Date	Membership
68	Chicago, Ill.	Oct. 14–16, 1963	887
69	Chicago, Ill.	Sept. 14–16, 1964	860
70	Chicago, Ill.	Sept. 13–15, 1965	829
71	Chicago, Ill.	Sept. 26–28, 1966	800
72	Chicago, Ill.	Oct. 11–13, 1967	799

Contracting Bridge and Building Work

Report of Special Committee

E. E. RUNDE, CHAIRMAN

Chief Masonry Inspector, Illinois Central, Chicago



E. E. Runde

In reviewing the information furnished by the committee members for inclusion in this report, it became very obvious that there is no general policy governing the contracting of bridge and building work by the various railroads. Some roads contract almost all such work, including routine maintenance. Others do almost all B&B work with company forces. The policy of many roads is to contract specialty work and perform routine maintenance with company forces.

The consensus indicates that most railroad management personnel would prefer to do as much bridge and building work as possible with company forces and to do only that work by contract which cannot be done by company forces for reasons which will follow later in this report.

The existence of the many and varied labor agreements is recognized and it is not intended to be critical of the provisions of any of these. Many of these labor agreements permit certain types of work to be performed by other than company forces and it is these that this report will deal with.

Before deciding on the types of B&B work which can be contracted, a study should be made to consider such questions as:

(1) Are men and equipment available to do the work with company forces at the time it should be done?

(2) Are these men skilled in the trades required for the particular work in question?

(3) Whether or not a desirable precedent can be established which will be in the carriers best interests.

The answers to these questions should be determined by each company on the basis of its own particular labor agreement, and the following remarks should be taken in that context.

We would like to comment that throughout this report you will find very little is said concerning the pros and cons of doing a job by contract or by company forces on the basis of economics alone. It is our opinion that this is the one aspect that should carry more weight in making this decision than all other reasons combined. However, in the arbitration of union-management disputes by outside parties, the question of the economics of a given situation has been consistently denied as being relevant.

Most railroads, at one time or another, have performed almost every conceivable type of bridge and building construction and maintenance by contract, and also by company forces.

No individual B&B worker, or group of

them, is expert in all classes of bridge and building work with which we are confronted today. It follows then that work requiring special skills and equipment not available from the company's roster or equipment pool, might better be handled by contract.

Included in this category are deep cofferdams and underwater construction in general, construction of large buildings, heavy earth-moving jobs, work involving patented processes and licensed specialists, new-line construction where the interruption or handling of traffic is not involved, and where off-track equipment of the type not commonly owned by the company can be used to advantage.

The maintenance and renewal of docks, wharves, floating and stationary sheer booms, and similar work which requires the use of floating equipment, is commonly performed by contract, again because of the special equipment and skills involved.

Some roads contract the temporary bridge work in connection with the construction of new undergrade crossings, especially when these are located on temporary runaround tracks. Embankment work for temporary runaround tracks is commonly performed by contract.

Emergency work which must be handled immediately in order to avoid damage to property and personnel should be handled by contract if railroad personnel is not immediately available.

If a choice must be made as to whether bridge work or building work should be contracted, it appears that, except for routine maintenance, most building work should be contracted because:

(1) Many more varieties of special skills and techniques are required.
(2) As a general rule, the safety of train operation is not involved.
(3) Very few railway employees are licensed to do the electrical and plumbing work required by many city building codes.

Many roads have central headquarters for their B&B gangs, who drive to the job and back from this headquarters for each day's work. This concept of a central headquarters limits the area in which they can effectively perform their work.

In considering the economics of contractor vs. company-force jobs, the comparative cost when the work might be done by company forces should always include an amount to cover fringe benefits, payroll taxes and equipment rental since similar costs are always included in any contract bid prices.

In recent years, a great many roads have found it difficult to hire qualified dependable workmen for assignment to floating gangs. As a result, it is becoming more difficult to keep a well-balanced work force.

The use of railroad company B&B forces that are accustomed to heavy timber construction and railway operations provides the most efficient and economical method of timber bridge construction and repair.

Many railroad B&B jobs must be done on a plan-as-you-go basis where the actual work to be done is unknown until underway. Such jobs could only be done by contract on a cost plus basis and in most such instances it would be more economical in the long run to do the work with company B&B forces.

A contractor can usually hire the number and type of skilled workers that he needs, reasonably close to the site of the work and, when no longer needed, they can be released. This of course is advantageous because overtime, traveling time or living expenses are rarely involved.

On most roads, the volume of work on a specific territory will vary greatly from year to year. Since it is not practical or economical to maintain a work force capable of handling the peak load, and if the work cannot be deferred, the excess can be handled advantageously by contract.

All of you are familiar with the procedures required to obtain materials and equipment to do work with company forces. A contractor does not have these problems, because he deals directly with his supplier and the savings in time are a distinct advantage. There are also potential savings to the railroads in that fewer back-up forces are required such as purchasing and stores, and, of course, savings are realized due to lower inventory accumulation.

In some cases, the quality of work required can only be obtained if done by a specialist. A contractor can employ such specialists when and as needed.

Contractors in many cases do not have sufficient knowledge of railroad operating rules and procedures to take proper advantage of traffic patterns or to realize the need of rigid safety requirements. They do not always understand the importance of maintaining traffic without interruptions, and in this respect, require close supervision. In most cases where contract work is done under traffic, it is necessary to have railroad employees assigned to the work to protect both the contractors and the railroad. This, of course, results in additional expense in some cases.

In many locations, local trade union rules will not permit the contractor's men to perform more than one class of work. This frequently results in jurisdictional disputes over which the contractor has no control.

In building construction, future maintenance frequently requires full knowledge of the original construction, particularly in the case of hidden wiring and plumbing. Unless the plans are completely revised as built to show the exact location of these utilities, contracting of the work can be a disadvantage.

In many cases, because of the uncertainties involved as to the exact nature and volume of the work to be done, cost-plus contracts are negotiated. Unless these jobs are very closely policed, they can get out of hand costwise. Most roads prefer unit price or lump sum contracting even though the prices may appear to be a little high in some instances to cover the uncertainties. At any rate, even cost-plus contracts should be negotiated on a competitive bid basis and close supervision is required while the work is being progressed.

There are certain types of work on bridges, such as changing out caps and stringers, legging piles and making repairs to steel bridges, that often must be done under traffic. This type of work cannot usually be handled by contract without very close supervision by railroad forces and, thus, it would be safer and more efficient to do it with company forces. One road, however, reports that it has done several jobs of this kind by furnishing key railroad men to operate on-track equipment and protect traffic while a contractor handled the work of renewing caps and stringers.

On some roads a specific job could be located in a sparsely populated, mountainous, forested or desert area and contracting of the work might not be feasible because of the non-availability of forces and living quarters. In these cases, railroad company forces with on-track equipment and portable housing would be more advantageous.

Specialty work, as the name implies, is work which, because of its special nature, is not routine or usual for the company forces to perform and would require the use of special or patented tools and processes. Some work might be considered a specialty because of its location. Thus, in some instances, a low flat roofing job would probably be considered as company force work, but a high, steeply-pitched roofing job would be considered as specialty work to be performed by contract because of the special scaffolding and hazards involved. Suffice it to say that any given type of work could be considered as either special or commonplace under different circumstances and each job should be judged on its own characteristics.

It is not reasonable to expect a B&B workman who is primarily a carpenter to have the know-how necessary for such specialty work as brick laying, terazzo flooring, ceramic tile work, asphalt paving, etc., nor is it practical to expect him to acquire a license, where required by local building codes, to perform electrical and plumbing work.

The extent or volume of much of the specialty work performed on the railroads is quite frequently indeterminate in advance and when handled by contract can usually only be done on a cost-plus basis. There are many variations of this type of contract but since the only actual indeterminates are the cost of labor and materials, the cost of supervision, equipment rental and profit should be negotiated on a fixed fee basis.

On this subject, the response to our request for information and suggestions indicated about 4 to 1 that the office engineering on special or large projects should be contracted, the consensus being that the engineering forces on most railroads are much too few in number and that these forces are fully employed doing the engineering in connection with routine company jobs which, because of company standards and practices and the close knowledge of these, could not be handled economically by an outside engineering force.

The contracting of field engineering services has also been done, but not so commonly, as office engineering. The trend on contracted construction work has been to require the contractor to be responsible for most field layout and engineering, so that the company engineering force can be held to a minimum.

The design and planning of a bridge or building should be based at the very beginning on whether it is to be constructed by company forces or by contract. If the work is to be done by company forces it should be planned so that all phases can be handled with company-owned equipment and skills. If it is to be done by contract, particular attention should be given to the way traffic is to be handled. The thought here of course is that most railroads are not outfitted with off-track equipment and very few contractors have on-track equipment.

In the design and construction of bridges and buildings, the prime consideration should be to build them as maintenance free as possible by the proper installation by skilled technicians utilizing the best material available.

It appears that most railroads are heading toward a stabilized work force and when budget or program exceeds what can be done by this force the balance will be contracted.

FORCES MORE EFFICIENT

The size of B&B forces has been greatly reduced in the past decade. However, the remaining forces are much more efficient and accomplish almost the same volume of work. This trend is primarily due to mechanization and must continue. All of our work must be as completely machine and equipment oriented as possible. The efficiencies and economics brought about or forced upon us by the changing times must be continued. It is no longer proper nor correct to consider using manpower without the benefit of equipment simply because it has been done for these many years.

Individual railroads must, of course, determine what course they are going to follow in contracting bridge and building work. The size of their B&B forces, the equipment they have, and the amount of work to be done will in the long run determine what work will be contracted.

A Brief History of Simple Span Concrete Structures Carrying Railroad Tracks

Subcommittee Report

J. J. RIDGEWAY, CHAIRMAN

Engineer, Bessemer & Lake Erie

There is much data available on the design and construction of this type of structure from many sources. Therefore, this report will be limited to a brief history of what has been, and is being done on the various railroads in this country.

The types and methods of construction has many factors. Climate, terrain, site accessibility, and casting facilities all have had their influences.

The earliest types were plain reinforced concrete, precast slabs mainly of short span. They go back to the early 1900's. Many of these are still in service.

With the advances of better concrete, reinforcing steel, prestressing and heavier erection equipment span lengths have increased and loadings have become heavier.

The evolution of prestressing started in the late 1880s when a patent for prestressing was issued to an American named Jackson. He used steel rods running through artificial stones and found by tightening the rods he could make the stones act as a unit. The steel available at that time would eventually fail by stretching thus destroying the integral action of the units. Prestressing was dormant until 1928 when a French engineer using better steel, concrete, and Jackson's principles started its ascent. Prestressing flourished in Europe and South America. The first such bridge constructed in this country was a highway bridge built in 1950. The first bridge carrying tracks was constructed in 1954. It was a pair of precast pretensioned slabs with a single span of 19′–0″ and a depth of 18″. It was designed for Cooper's E-72 live loading. The two halves were posttensioned for stress distribution.

From this beginning various forms of beams and slabs have evolved. Solid slabs, solid T-section beams, rectangular beams, circular voided beams, rectangular voided beams, and rectangular voided slabs. The rectangular void has gained favor over the circular void due to its ease of forming.

Prestressing combines the best properties of concrete and steel, the compressive strength of concrete and the tensile strength of steel. Using higher strength concrete and steel than in conventional construction results in a higher strength to cost ratio. Prestressing reduces the depth to length ratio. This permits greater clearance and longer spans.

One railroad uses conventional precast slabs with high strength steel reinforcing bars. Span lengths of 26′, 27′, and 28′ designed for E-72 are used. Prestressing steel does not act as reinforcing steel. It eliminates the occurrence of tensile forces in the beam. In pretensioning the concrete is in contact with the steel and stress transfer is by means of bond. In posttensioning the concrete is not in contact with the steel. Stress is transferred by stretching the steel and attaching anchors at the beam ends.

Both pretensioned and posttensioning

have been used. Shear keys filled with either mortar or more recently expoxies for lateral transfer of stress is in use. Steel for posttensioning is also used for this lateral transfer. Structures using a pair of slabs with no lateral transfer means is also used. The assumption being made that each carry 50% of the load.

The first long span structure was of posttensioned T-section beams. Four sections of 69′–10″ span were used. Each beam weighed 60 tons and was designed for E-72 loading.

A recent installation has been made with spans up to 86′. These are through voided box beams. A pair of beams used in a span. Another recent structure is a 10′ wide, double voided beam of 60′ length designed for E-80.

As in the variety of beams and girders there is much variety of bent arrangement. Various combinations of pile and cap construction being used.

Various economies are claimed by different railroads and vary by the previous stated conditions in paragraph 2.

There has been considerable field and laboratory research done on this type of structure. Reports of this research are available from the various agencies that have conducted it.

A film prepared by Portland Cement Association showing the casting, transporting, and erection of the 86′ beams used by the Southern Pacific Railroad on their Palmoale–Colton Cutoff construction was shown. Mr. Tom Fuller, Bridge Engineer of the S.P. narrated and answered questions from the floor.

Butyl Rubber as a Waterproofing Membrane

Subcommittee Report

J. I. REEVES, CHAIRMAN

Assistant B&B Supervisor, Gulf, Mobile & Ohio

Impermeability and as long a useful life as possible are the principle qualities desired in the selection of waterproofing membrane! What then are the qualities of Butyl Rubber that makes it of value to the construction field and to the Railroads in this case? As to its impermeability, if Butyl Rubber is assigned an arbitrary permeability factor of 1.0, then polyethylene film rates 1.9 times as permeable, polyvinyl chloride rates 59.0 times as permeable, and a preferred asphalt membrane rates 22.0 times as permeasble. Butyl Rubber's imperability is evidenced by the fact that since its discovery it has been used as the material of which is made auto and truck inner tubes.

The impermeability of Butyl Rubber led the Agricultural Research Service of the Agriculture Department to evaluate its use, starting in 1947, as a ditch liner to eliminate seepage loss in western irrigation ditches. In this application the rubber sheeting would be exposed to a succession of freeze and thaw cycles, soil bacteria and rot, organic and inorganic liquids, and in handling the rubber would be subject to abrasion and puncturing. Because of the results of this evaluation, Butyl Rubber sheeting is widely used today to line waterways and reservoirs for water conservation.

Applications of Butyl Rubber to Railroad facilities include its use as a waterproofing membrane on ballast deck bridges, a waterproofing membrane for below grade structures such as scale pits, meter vaults, and basements, a roofing material which is bonded to the roof surface, and lastly as a vibration dampening and isolation pad between the rail and tie.

In the use of Butyl Rubber as a waterproofing membrane for ballast deck bridges, a rubber sheet, generally 1/16″ thick, is laid down on the deck of the bridge. The deck cleaned off to avoid puncturing the rubber. The rubber sheet can be laid directly upon the deck or can be adhered to the deck with a Butyl adhesive. After the sides of the rubber sheets have been brought up the sides of the ballast retainers, the rubber sheet is covered with a layer of cushion material, usually an asphalt plank. Rubber sheeting of sufficient width can be supplied for a bridge with a single track. To aid in handling for waterproofing wider surfaces, separate sheets can be unrolled and bonded together to form an unbroken membrane. No special equipment is necessary to produce the bond as it is essentially the same as applying a cold patch to an automobile inner tube.

In waterproofing below grade structures, the Butyl Rubber is used to form a boot which completely encloses the structure. A typical application to that of a scale pit would have the foundation and floor poured on top of a Butyl Rubber sheet. As the vertical walls of the pit are brought up to above grade, the rubber sheeting is also brought to a point above grade. Vertical seams and corners are bonded with Butyl adhesive.

The use of Butyl Rubber has the same qualities of wearing and life expectancy on a roof as compared to the above subjects. In applying a Butyl Rubber sheet roof the area is first swept clean to remove foreign material. The rubber sheets are unrolled and allowed to "relax" for 30 minutes to arrive at dimensional stability. The rubber sheets are then folded in half along the length and a coating of Butyl adhesive is applied to the underside of the rubber sheet and to the roof to which it will be adhered to. After allowing the adhesive to set, the sheeting is joined to the roof surface and rolled to eliminate trapped air. Adjacent sheets are lapped three inches and are joined with a Butyl gum tape and adhesive.

Butyl Rubber sheeting is a material which we feel will warrant further investigation into the subject by anyone faced with a waterproofing problem.

This short article will not answer all your questions on the subject, but will have brought the existence of and the possibilities of waterproofing with Butyl Rubber.

Slides showing various installations of Butyl Rubber for waterproofing concrete bridges in Chicago area were shown and discussion conducted.

Small Portable Tools for B & B Work

Subcommittee Report

G. R. VANDERPOOL, CHAIRMAN

Bridge Engineer, Atchison, Topeka & Santa Fe

This committee has prepared two lists of tools, one list is of the basic tools for a typical gang consisting of a foreman and eight men. The second list is a short list of tools that have been placed on the market within the last two years. A third list is under consideration; this list could be of great importance since it will list tools needed to do certain jobs but are not yet available.

The help of every member of the Association is requested to improve and keep these lists up to date. Also the help of everyone is requested in making the third list. Suggestions from members are requested. Without this help, these lists cannot be properly prepared or kept up to date.

The lists of new tools and tools needed are of special interest to sales personnel. List No. 2 will keep B&B personnel abreast of what is new in their field even though brand names or manufacturers names cannot be included on these lists. Sales representatives are requested to help keep this list up to date. Likewise, the list of tools needed but not available will serve as a guide to the needs of the B&B departments.

The remainder of this report will deal with electric tools. Later reports will cover air, gasoline and hydraulic tools.

A small portable tool can be defined as being a tool normally used by one man. The purpose of any tool is to increase the efficiency of the man using the tool, or increasing one's production by increasing his speed and at the same time reducing the fatigue of the job so that the increase in speed can be maintained.

First, in the selection of tools, look for a tool that will do a given job in less time with less fatigue to the user. After determining the tool for the job, the question arises as to what other jobs can be done with this tool, in other words, just how versatile is the tool. Once the tool is on the job, it will be surprising to see how many more uses the men find for it than was anticipated.

Second, after the tool has been found that will do the job, the next question is whether or not the men will use it. If it is harder to handle than the tool it replaces, it probably, will not be used and its efficiency is decreased and the saving anticipated will not be realized.

The weight of a tool effects its efficiency a great deal. Generally speaking, a tool for continuous use over long periods of time that weighs over 7 pounds but less than 15 pounds should be equipped to be handled with both hands. Tools for intermittent use should not weigh more than 20 pounds and any tool weighing over 20 pounds should be considered for two-man operation. Otherwise, it probably will not be used or if it is used by one man, the efficiency will be lost by fatigue. Electric tools generally meet these weight requirements. In the last few years, weights of electric tools have been decreased by almost 50% in some cases.

In most instances, the cost of first line electric tools is about half of that of air tools which in turn costs less on an average than hydraulic tools. The power source for electric tools is usually less expensive than for the other types of tools.

In deciding on tools, the life of a tool is also important. The life of electric tools is about ten years. Air and hydraulic tools will last about 25 years. Due to rapid technological changes, at present, all tools become obsolete in from 10 to 15 years. Manufacturers tend to discontinue production of older models as they are replaced by new improved models. One manufacturer may take over another and discontinue the production of that line of tools; thus, repair parts are not available and the tool cannot be repaired and breakage, loss or wear of any part of the tool ends its life.

The cheaper price of the electric tools allows taking advantage of improvements more often and avoiding loss of tool life due to obsolescence, as they can be replaced twice as often as the air or hydraulic tools.

The present electric power plants are relatively light weight. For example, a 5 K.W. power plant can be easily carried by two men and will provide power for all tools suitable for bridge work. One man can carry a 2.5 K.W. power plant that will provide adequate power for most tools except chain saws. Heavy impact tools should not be operated with another tool or on long extension cords or for long periods of time with the 2.5 K.W. plants. This would not be the case with a 5 K.W. power plant since it has adequate capacity.

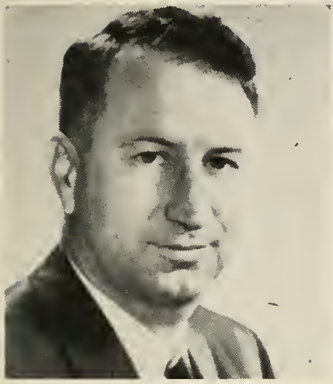
Compliments of a Friend

Renewal of Bridge and Trestle Ties Under Welded Rail

Report of Special Committee

R. E. FRAME, CHAIRMAN

Chief Engineer, Southern Pacific, Texas & Louisiana Lines



R. E. Frame

Continuous welded rail has been with us long enough now that we are all well aware it has raised several new problems for bridgemen; but in general our experience in working on bridges with continuous welded rail is still rather limited, and there is some lack of agreement as to the nature and seriousness of the problems involved.

In discussing the renewal of bridge ties under welded rail with the men who have done it, or who are going to do it, two distinct groups become apparent: (1) The people in this group (who perhaps have had some bad luck, or haven't actually done it yet) who seem to think that there are all kinds of unpredictable dangers and complications involved, and they would like to avoid the whole subject if at all possible; and (2) those in this group who say that it's just the same old thing and they do the work just as they always have done it, with no problems at all; maybe they are just the lucky ones.

There is probably a good deal of truth to both viewpoints; we don't completely understand yet how continuous welded rail works even in ballasted track, let alone on a bridge, and some of the things we observe happening with it seem hard to explain, let alone predict. However, continuous welded rail seems to be here to stay and all we can do is tackle it head on. Maybe some of the problems will disappear entirely; surely we will find answers to the ones that are left.

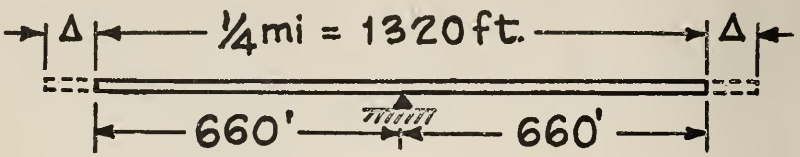
A few observations will be made on the technique and problems involved in renewing bridge ties on open-deck bridges which have been laid with continuous welded rail. By continuous welded rail we mean rails that have been welded into continuous lengths of 400 ft or longer.

Basically, the problem in renewing bridge ties under welded rail is that the anchorage and lateral restraint must be removed for some length while doing the work. There are at least three possibilities of trouble connected with this: sunkink, pull-apart and changing the pattern of end restraint.

The phenomenon known as "sunkink" has always been with us and is essentially no different with welded rail than with jointed rail after the joints have become tight. It is caused by lateral buckling of rail that has been prevented from expanding during an increase in temperature. Since continuous welded rail doesn't have the free travel in the joints before becoming tight, it takes less of an increase in temperature to make buckling a possibility with continuous welded rail, and also it is not possible to tell by inspecting the joints whether or not the rail is tight. The only clue is the change in temperature since the rail was anchored.

A hazard which is less obvious than a sunkink is a pull-apart at the joint. Ordinarily, this will be a possibility only when the joint is on or near the end of a bridge and the anchors are removed for quite some distance in very cool weather. A pull-apart can be a very troublesome occurrence, though, and the possibility should not be overlooked.

A really new problem area that welded rail has brought to bridgemen is concerned with the different role played by rail anchors. With conventional and, the primary



$$\Delta = \ell e(t - t_0)$$

$$= 660\ \text{ft} \times 0.0000065\,\frac{\text{in/in}}{{}^\circ\text{F}} \times 75^\circ\text{F} \times 12\,\frac{\text{in}}{\text{ft}}$$

$$= 3.86\ \text{in}$$

$$\sigma = Ee(t - t_0)$$

$$= 30000000\,\frac{\text{lb}}{\text{in}^2} \times 0.0000065\,\frac{\text{in/in}}{{}^\circ\text{F}} \times 75^\circ\text{F}$$

$$= 14{,}600\ \text{lb/in}^2$$

$$P = \sigma A = 14{,}600\,\frac{\text{lb}}{\text{in}^2} \times 11.65\ \text{in}^2 = 170{,}000\ \text{lb.}$$

Fig. 1

purpose of anchorage is to prevent the rail from creeping under traffic. With continuous welded rail, they must also develop the restraint necessary to resist the changes in length caused by temperature changes. Two years ago G. M. Magee, director engineering research, AAR, discussed the theoretical aspects of this problem quite thoroughly, pointing out that movement in a common ¼-mile length of continuous welded rail seems to be confined to the first eight rails, or about 300 ft at each end, with the central portion remaining essentially fixed.

This results in two quite distinct situations: first, where the joint occurs on or near the end of the bridge, and the bridge must resist the thermal force of the rail; second, where the bridge is located in the central portion of the rail, and the rail does not move but the bridge must expand under it.

As is the case with anchoring jointed rail, there seems to be a lack of agreement in the practice of anchoring continuous welded rail to bridges. Some railroads anchor all bridges and let the joints fall where they may; some avoid joints on or near a bridge and don't anchor any bridges; and some anchor only those bridges where necessary to restrain the rail ends. Apparently this is not too great a problem, since all those railroads who responded to questionnaire on anchorage patterns were satisfied with their present system of anchorage. However, removing and replacing the anchors while changing ties certainly changes the pattern of restraint, and the date probably should be recorded, along with the prevailing temperatures, and kept with the original record of the temperature when the rail was laid—at least until it is determined definitely whether this is, in fact, a problem.

These, then; are some of the problems involved in working on bridges under continuous welded rail. As we gain more experience in the work, some of these problems may just disappear, and new ones may arise. And we are surely going to get

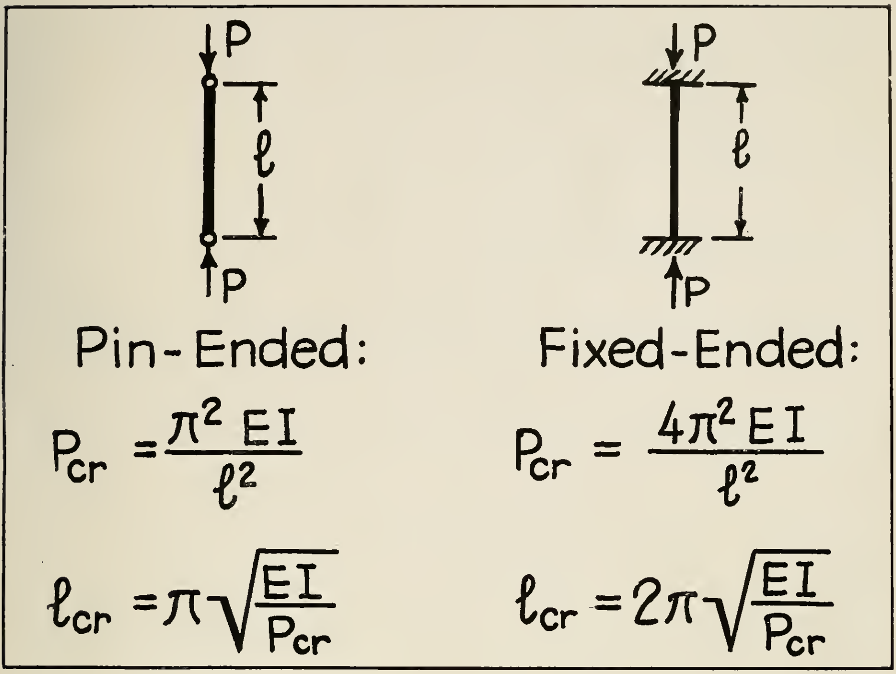

P
ℓ
P
Pin-Ended:
$P_{cr} = \frac{\pi^2 EI}{\ell^2}$
$\ell_{cr} = \pi\sqrt{\frac{EI}{P_{cr}}}$
P
ℓ
P
Fixed-Ended:
$P_{cr} = \frac{4\pi^2 EI}{\ell^2}$
$\ell_{cr} = 2\pi\sqrt{\frac{EI}{P_{cr}}}$

Fig. 2

more experience: a sampling of railroads representing about 18,000 miles of main line and 4,500 miles of branch line indicated that about 12% of the main track and 2% of the branch track is already laid with continuous welded rail, and that jointed rail is being replaced with continuous welded rail at the rate of about 2% of the total mileage per year. In this 15,000 miles of main track, there are about 72 miles of open-deck bridges, and about 45 miles of open deck structures, on the 4,500 miles of branch trackage. It's safe to say that a sizable percentage of these decks were last renewed in the '40's and will soon be getting ripe again.

ACTIVE PROGRAMS

Many railroads have an active program of replacing open-deck bridges with ballast decks and this practice certainly has many points to recommend it, but unfortunately it is not always possible. For instance, in a through-truss structure, the headroom will seldom allow the necessary raise in track and some structures just cannot be economically altered to a ballast deck without complete renewal of the structure.

Another way of avoiding the problems of renewing bridge ties under continuous welded rail, adopted by some railroads, is to renew the ties before laying rail. This really doesn't solve any problems; it just puts them off on the next generation of bridgemen.

Some railroads also avoid locating joints on or near bridges. This does avoid some anchorage problems, but still leaves the possibility of sunkinking. It would also seem to interfere considerably with an efficient program of laying continuous welded rail in continuous strings of uniform length. An alternate solution which might be worth consideration is to field-weld the joints near bridges, in effect lengthening the center, unmoving section of rail.

FORCES AND MOVEMENTS

Now let's look in a little more detail at the situation. It might help if we first

$$(1)\quad P_t = AEe(t-t_o)$$

$$(2)\quad \ell_{cr} = \pi\sqrt{\frac{EI}{AEe(t-t_o)}}$$

$$(3)\quad \ell_{cr} = \frac{\pi r}{\sqrt{e}\,\sqrt{t-t_o}}$$

$$(4)\quad \text{Pin-end-}\ell_{cr} = \frac{3.1416}{\sqrt{.0000065}}\,\frac{1}{\sqrt{t-t_o}}\,\frac{1}{12} = \frac{113.5\text{ ft}}{\sqrt{t-t_o}}$$

$$(5)\quad \text{Fix-end} = 2\times\text{Pin-end} = \frac{227\text{ft}}{\sqrt{t-t_o}}$$

$$(6)\quad \ell_a = \frac{150\text{ ft}}{\sqrt{t-t_o}}$$

Fig. 3

look at a section of welded rail—say a quarter of a mile long—and briefly review just what forces and movements we are talking about. If we assume that this section of rail is held fixed at the center and both ends are free to move, and that the temperature changes 75 deg F, then each end will move 3.86 in. (Fig. 1). If the ends are prevented from moving this much, there will be an increase in the internal force equal to that required to stretch or compress the length of rail this distance. For a 119-lb. rail, this is a force of about 170,000 lb which must be resisted by the rail anchors and joints.

Now let's say that we have a bridge in the central unmoving portion of the rail, and that the temperature has increased. The danger here is the possibility of humping or sunkinking, and the problem is to determine just how far it is safe to pull the spikes and remove the line and hold-down bolts. One approach to getting an answer follows:

The rail here is acting like a long slender column with lateral restraint. This slide (Fig. 2) shows Euler's well-known formulas for the critical load on a column; that is, the load which will just cause buckling. You will notice it is four times as much for a fixed-ended column as for one with pinned ends. Below, each formula has been rearranged to show what might be called the critical length for the critical load. Notice that we took a square root, so that the critical length for a fixed-end column is only twice that for one with pinned ends. The symbols are all familiar: "E" is the modulus of elasticity, "T" is the moment of inertia of the rail, etc. Next (Fig. 3), formula (1) gives the force, P_t, in the rail caused by a change in temperature $(t - t_o)$. "A" is the area of the rail, and "e" is the coefficient of expansion of steel. Substituting this into the pin-ended column formula (2) and recognizing that $\sqrt{IA} = r$, the radius of gyration reduces to this formula (3) where the only variables are "r" and the change in temperature. Since most rails are about six times as stiff about their horizontal axis as about the vertical one, it would seem reasonable to consider the possibility of sunkink first, and take this "r" as being about the vertical axis. For most of the rails in use today, this dimension is very close to one inch. If we use this value, and substitute in the numerical values for the other knowns (dividing by 12 to get the answer in feet) we get for a pin-ended column, formula (4). For a fixed-ended column this length would be twice as much, but since a rail is neither completely fixed nor completely pin-ended, it would seem permissible to take a figure on the conservative side of the average, which also has the advantage of being easier to remember.

This should give the length in feet that it is safe to remove lateral restraint without danger of kinking. Now we do not guarantee this formula because as far as we know it has not yet been tested and it may be overly conservative; also, an initial slight kink in the rail could change the whole situation; but it does give results which seem reasonable. For instance, for a moderate temperature increase of 25 deg. this formula would indicate you could release the track during the replacements for about 30 ft. for a 50-deg rise, about 21 ft, and for an extreme case of a 100-deg rise, only about 15 ft.

There is also always the possibility of humping, which is aggravated by the fact that the track must be jacked up somewhat to allow insertion of new ties. But since most rails are about six times as stiff in this direction, it would seem that if the vertical restraint were not removed for much more than about twice as far as the lateral restraint, this should be a minor hazard. Obviously, since we are dealing with rather unpredictable conditions, reasonable restraint should be restored before allowing traffic over the work area. This should include some positive hold down devices as well as line bolts.

WHEN RAIL IS IN TENSION

Now we come to the case where the rail is in tension—that is, where there has been a decrease in temperature. If the bridge is in the center portion of the rail, this is the ideal situation, and some railroads restrict the renewal of bridge ties to periods of cool weather. However, the ambient temperature is only half the story—the important thing is the change in the temperature of the rail since it was anchored. One case is known of a sunkink when the air temperature was in the 30's and one bridge foreman found out he could sweat plenty over a sunkink under cloudy skies.

If the joint comes on or near the end of the bridge, the situation is considerably different. Here, as mentioned before, the bridge ties must develop the tension in the rail and removing the anchors can put quite a strain on the rail joint.

We have some slides of a job which illustrate this situation pretty well. We'd like to discuss the job a little before we look at them.

This bridge is a series of four through trusses in south-west Texas, where the temperature variation can sometimes be rather extreme. The whole bridge is about 560 ft. long, and is laid with welded rail, the east joint being just a few feet east of the east end of the bridge. East of this is all jointed rail.

During the first week on the job, while the gang was unloading ties and preparing for the work, the air temperature only got up to 103 deg and since the rail had been laid in August two years before, there was no concern about sunkinks or pull-aparts, and they renewed the ties in the first panel on Friday with no problems. The next Monday and Tuesday were even cooler—in the 90's—and work progressed smoothly; they almost finished the first span and had taken off the anchors on the next two.

AN ANXIOUS TIME

Tuesday night one of the so-called Texas "northers" moved in, and Wednesday morning it was in the low 50's. The joint on the south rail was just a little farther open than it should have been and there was an anxious time until the sun warmed up a little and closed the gap enough that it obviously wasn't going to pull apart. From then on you can be sure that the anchors were kept up with the work.

This first slide shows the general arrangement in beginning work on a panel. There are two gangs of about five men each; one gang is equipped with an Austin-Western crane with flanged wheels and brings the new ties (about 7 at a time) from the stockpile at the west end of the bridge. Tie plates have already been applied at the tie plant. The other gang is equipped with a hand-operated crab car and a push car, and while the Austin-Western is getting the new ties they pull spikes and jack up the track and get ready to remove the old ties. Here the new ties have been set down and both cranes are working together; the motor crane hooks between the rails and slides the tie out, where the crack car hooks it and swings it around and loads it on the push car.

This process requires about 50 seconds per tie.

In the next slide, all of the old ties have been removed and two men have taken the push car to the east end of the bridge to unload them. Now the two cranes are working in the reverse order: the motor crane slides the tie under the rail, and the crab car picks it up between the rail and sets it in final position. This process took about two minutes per tie, since some care is required in spacing them properly and they are handled more carefully to avoid injurying the treated wood.

This slide shows the deck ready to remove the old ties. You will notice that new guard timber is carried up with the new ties as close as possible, and that the old guard timber is removed only in the immediate work area. You will also notice the bolt driven in the tie just this side of the floorbeam. This is to help provide lateral restraint.

This slide shows the track being prepared for traffic. The guard timber didn't quite come out even on this side, so the hold-down bolts that you see there were put in with malleable washers and nuts on the bottom to hold the ties down to the flange of the stringer. That shoe was put on top to make it easier to remove the bolts later when placing the new guard timber.

RAIL CREEP

This view shows the relationship of the joint in the south rail to the end of the bridge. Certainly here the bridge is taking all the force of the rail. And finally, this is how the joint looked in the morning after the abrupt temperature drop. The gap is almost an inch, which is surely all the free travel possible in the bolt holes, but notice from the marks on the tie plate on the right that the whole rail has actually crept west.

This is one way of doing the job. It's pretty much the same way it has always been done on this railroad. Incidentally, the production averaged about 4½ mins of track time per tie, including opening up and closing up for traffic. This is about the same time spent when using this same method with conventional rail.

There are many other, and perhaps better, ways to do the job. For instance, some railroads, working under jointed rail, have assembled their ties in panels off the bridge, complete with guard timber and tie plates, then removed the rail, removed the old ties, and replaced a panel or more at a time. This method requires less track time, but more preparatory time and more planning and supervision. As far as is known, this has not been tried under welded rail, but it might be feasible to remove and replace one panel of track at a time, using one of the processes of field welding.

We have been discussing problems encountered when using continuous welded rail on bridges. This is not to infer that we have anything against it's use. Quite the contrary, we are entirely in favor of it. It does present a few new problems, but in getting rid of the joints on the bridge it solves a lot of old ones. Since it was usually the joint ties that went to pieces first ties now should last longer, and elimination of the vibration from the joints will be reflected in less maintenance required on steel bridges.

A LITTLE EXTRA CARE

The problems involved in renewing ties under welded rail are not entirely new; it's just that they are somewhat magnified and we don't yet entirely understand them all. It's probable that continuous welded rail sometimes does increase the chance of having a sunkink during the tie-renewal process and pull-apart was something that was usually of little concern with jointed rail, but with a little extra care both of these possibilities can be avoided. A benefit of this little extra care in tying down the track structure is that the work can be done with a less restrictive slow order than was usual in renewing ties in jointed rail. For instance, during the job discussed here, a slow order was used for only about two working days when it was necessary to shim up a run-off, the rest of the time trains operated at timetable speed.

As far as the problem of anchorage is concerned, we should wait for the results of current tests being made on continuous welded rail in a ballast section before attempting to make any recommendations. For the present it would seem that a reasonable amount of care in keeping the track structure anchored is all that is required.

One thing that is essential in doing any work under welded rail is a reliable record of the temperature when the rail was laid and anchored. This record should be readily available to the men doing the work, and as suggested before, perhaps should include a record of any time the anchors are removed and replaced or adjusted.

The ideal situation, of course, not just from a bridgeman's standpoint, but for efficient railroad maintenance in general, is to have all bridges ballast deck. This would not only minimize or eliminate most of the problems discussed, but would allow unrestricted use of mechanized track-maintenance gangs.

To hope for the realization of this ideal in our time is unrealistic. Anyway, continuous welded rail and all it's problems will soon be old hat to bridgemen.

Heavy Construction Tools

Subcommittee Report

J. W. CHAMBERS, CHAIRMAN

Bridge Construction Engineer, Missouri Pacific

J. W. Chambers

Last year the first report of your committee on heavy equipment was a profile of what was in general use by railroads for bridge work. This report outlined what was in use a few years ago, what was currently being used, and what might be expected a few years from now.

The committee mentioned changes that have taken place, improvements, what were in process of change with respect to locomotive cranes, pilehammers, pile drivers, leads, earth drills, truck cranes, etc., and painted out a few relative advantages and disadvantages of some of the equipment.

This year it was decided that your committee would dwell upon one subject only and that it would be pile hammers. This would not necessarily exclude pile hammers from future reports. After all, when we are discussing bridge equipment, there can hardly be a discussion without including hammers. That is the name of the game.

It is not our purpose to recommend to the membership a particular piece of equipment. It is not the intention of this committee to point the finger at one item and say—this is the best, this is the most economical, this is the one to buy.

This assignment is informative in nature in that we will try to show you from time to time, from the material gathered, what equipment other railroads are using and how they adapt it to their particular needs and circumstances. All of which may give each railroad an idea they can put to use to their advantage or by combining other ideas come up with something suitable to their needs.

Each railroad has its own particular circumstances to contend with along with its own particular requirements.

It is not therefore, the intention of this committee to criticize, condemn, or approve. The report will consist of what is found, and each one can evaluate it in the light of their own circumstances. Included in this evaluation must be finances, location, union agreements and probably many other items that govern what can be used.

In addition, information concerning some items in use by contractors may be beneficial. From this, an idea may be born to adapt something that would be a time saver to B&B crews and/or increase their productivity.

As is the case in any piece of equipment pile hammers come in a variety of sizes, shapes, and intended usage. There are probably 700 on the market today. They range from small ones for driving tent stakes and plank sheeting to the gigantic hammers used in off shore driving. Somewhere within that range are the hammers railroads require, and they sometimes have a chore in deciding which hammer to use. Among the items that determine this—aside from cost—are: what kind of pile will it be driving the majority of the time, what will it be used with, a pile driver, a locomotive crane, truck crane or crawler? Can the rig handle this hammer and leads? The size of existing leads and existing cranes may be factors.

Perhaps a railroad is getting a new crane with higher capacity. Existing leads may have to be altered or even new ones purchased. It all boils down to individual needs and requirements.

A railroad that has a large pile driving program every year will vary likely have more than one size hamper in order to cover as wide range of driving conditions and size and types of piling as possible, with as few hammers as possible. In fact they may require several of each size. However, pile hammers for one time special conditions can be rented with economy.

Smaller railroads that do not have heavy driving commitments can rent hammers and related equipment as needed. In choosing what they need they have the added advantage in that they can pick the equipment exactly suited to the job.

In the interest of economy those who have several hammers working the year round try to increase the range of those they have on hand. It is done more often than one would think; using too small a hammer on a heavy piling, or too heavy a hammer on a light piling. This is not a major crime if this done on rare occasions and results obtained are satisfactory. It is certainly more economical to do this than having a hammer on hand that is only used 2 or 3 times a year. On the other hand when those rare occasions become numerous—and a habit—or a volume can be anticipated, it is time to think of another hammer in the range to take care of the situation. Much time can be frittered away with too light a hammer, and a lot of piling can be ruined with a hammer that is too heavy if care is not exercised. In some instances one size hammer will handle all of a railroads requirements. They may be standardized to that extent. However it is generally a mistake to choose a hammer with the intention that it is a cure all for all of your driving requirements. That is to determine the majority size pile you use and figure on stretching the range of the hammer at both ends to take care of any other size or type of piling that are actually beyond ths scope of a particular hammer. One railroad did this and instead of driving the number and size piling for which the hammer was purchased, they actually drove more of a lighter weight piling. They were continually frustrated in the time it took to build up resistance in the pile in order to keep the hammer operating. In addition they were continually afraid of ruining piling. In other words, no one hammer is a general purpose tool. If this were so, there would only be the one on the market. Regardless of make, all hammers have their place. One is better than the next depending only on requirements to meet, the successes or failures encountered in past use and, in some instances personal preferences which have been developed in the past.

In the past few years the competition among pile hammer manufacturers has become very intense. The preponderance of new construction going on, including railroads, has made the demand such that they are all searching for something new and better to put on the market and are continually advertising improvements to existing models. For example: one company is now advertising a convertible diesel hammer. A cap can be put over the top of the cylinder to get a faster stroke or the cap left off for a slower stroke. This is not the place to argue the point on increase or decrease of delivered energy.

HAMMER REQUIRES LESS AIR

In another instance, a double acting air hammer is being developed that operates on a much lower volume requirement than present air-stream hammers require but will still give very nearly the same blows per minute. In terms of cost of air compressors for the volume required now, very material savings are involved in overall costs which could influence the choice of a hammer. Further than this, work is also being progressed toward a hydraulic pile hammer. Again, economics can readily be seen in operating costs. There is no doubt that in the near future there will be one of these on the market.

Finally, the vibratory hammers are now in widespread use by the construction industry. As in all new things as time passes refinements are made. It is not unreasonable to assume that these will be developed further into possibly a smaller package and a wider variety of usage that would become acceptable to, and economically feasible for railroad use.

All of this points up the fact that the manufacturers are busy competing. In the long run we are the winners. It would be prudent for each railroad to discuss their driving requirements with several manufacturers,—manufacturers representatives want to sell railroads hammers that meet their needs and requirements.

At this time your committee would like to request all members to submit slides or photographs that can be made into slides of heavy equipment in action. This will enable your committee to keep the association informed of current practice. Although the equipment may seem obsolete or outdated, or on the other hand completely up to date, the picture will serve to keep the association informed of changes and development.

We are trying hard not to limit our reports to what just 2 or 3 railroads are using. For your committee to be a success and to report upon as wide a range of equipment usage as possible we must have information from as wide a range as possible to be truly representative. Please send any pictures to the committee chairman.

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Executive Members	G. Aaldrich	G. W. Rear	W. F. Steffens	W. F. Steffens
	P. Swenson	W. F. Steffens	E. B. Ashby	S. C. Tanner
	G. W. Rear	E. B. Ashby	S. C. Tanner	Lee Jutton
	W. F. Steffens	C. E. Smith	Lee Jutton	F. F. Strouse
	E. B. Ashby	S. C. Tanner	W. F. Strouse	C. R. Knowles
	W. O. Eggleston	Lee Jutton	C. R. Knowles	A. Ridgway

	1915-1916	1916-1917	1917-1918	1918-1919
President	G. W. Rear	C. E. Smith	S. C. Tanner	Lee Jutton
1st V.-Pres.	C. E. Smith	E. B. Ashby	Lee Jutton	F. E. Weise
2nd V.-Pres.	E. B. Ashby	S. C. Tanner	F. E. Weise	W. F. Strouse
3rd V.-Pres.	S. C. Tanner	Lee Jutton	W. F. Strouse	C. R. Knowles
4th V.-Pres.	Lee Jutton	F. E. Weise	C. R. Knowles	A. Ridgway
Sec.-Treas.	C. A. Lichty	C. A. Lichty	C. A. Lichty	C. A. Lichty
Executive Members	F. E. Weise	W. F. Strouse	A. Ridgway	J. S. Robinson
	W. F. Strouse	C. R. Knowles	J. S. Robinson	J. P. Wood
	C. R. Knowles	A. Ridgway	J. P. Wood	A. B. McVay
	A. Ridgway	J. S. Robinson	D. C. Zook	J. H. Johnston
	J. S. Robinson	J. P. Wood	A. B. McVay	E. T. Howson
	J. P. Wood	D. C. Zook	J. H. Johnston	C. W. Wright

	1919-1920	1920-1921	1921-1922	1922-1923
President	F. E. Weise	W. F. Strouse	C. R. Knowles	Arthur Ridgway
1st V.-Pres.	W. F. Strouse	C. R. Knowles	A. Ridgway	J. P. Wood
2nd V.-Pres.	C. R. Knowles	A. Ridgway	J. S. Robinson	J. S. Robinson
3rd V.-Pres.	A. Ridgway	J. S. Robinson	J. P. Wood	C. W. Wright
4th V.-Pres.	J. S. Robinson	J. P. Wood	C. W. Wright	E. T. Howson
Sec.-Treas.	C. A. Lichty	C. A. Lichty	C. A. Lichty	C. A. Lichty
Asst. Sec.			F. E. Weise	F. E. Weise
Directors	J. P. Wood	C. W. Wright	E. T. Howson	F. C. Baluss
	A. B. McVay	A. B. McVay	J. H. Johnston	Maro Johnson
	J. H. Johnston	G. A. Manthey	E. K. Barrett	O. F. Dalstrom
	E. T. Howson	E. T. Howson	F. C. Baluss	S. D. Corey
	C. W. Wright	J. H. Johnston	Maro Johnson	W. B. Hotson
	G. A. Manthey	E. K. Barrett	O. F. Dalstrom	P. N. Nelson

	1923-1924	1924-1925	1925-1926	1926-1927
President	J. S. Robinson	J. P. Wood	C. W. Wright	E. T. Howson
1st V.-Pres.	J. P. Wood	C. W. Wright	E. T. Howson	F. C. Baluss
2nd V.-Pres.	C. W. Wright	E. T. Howson	F. C. Baluss	Maro Johnson
3rd V.-Pres.	E. T. Howson	F. C. Baluss	Maro Johnson	J. S. Huntoon
4th V.-Pres.	F. C. Baluss	Maro Johnson	J. S. Huntoon	C. S. Heritage
Sec.-Treas.	C. A. Lichty	C. A. Lichty	C. A. Lichty	C. A. Lichty
Asst. Sec.	F. E. Weise	F. E. Weise	F. E. Weise	F. E. Weise
Directors	S. T. Corey	J. S. Huntoon	C. S. Heritage	A. I. Gauthier
	W. B. Hotson	A. I. Gauthier	W. B. Hotson	E. L. Sinclair
	P. N. Nelson	E. L. Sinclair	P. N. Nelson	P. F. Dalstrom
	J. S. Huntoon	C. S. Heritage	A. I. Gautheir	W. T. Krausch
	A. I. Gauthier	W. B. Hotson	E. L. Sinclair	R. C. Bardwell
	E. L. Sinclair	P. N. Nelson	O. F. Dalstrom	H. I. Benjamin

	1927-1928	1928-1929	1929-1930	1930-1934
President	F. C. Baluss	Maro Johnson	J. S. Huntoon	C. S. Heritage
1st V.-Pres.	Maro Johnson	J. S. Huntoon	C. S. Heritage	A. I. Gauthier
2nd V.-Pres.	J. S. Huntoon	C. S. Heritage	A. I. Gautheir	H. I. Benjamin
3rd V.-Pres.	C. S. Heritage	A. I. Gauthier	H. I. Benjamin	W. T. Krausch
4th V.-Pres.	A. I. Gautheir	H. I. Benjamin	W. T. Krausch	T. H. Strate
Sec.-Treas.	C. A. Lichty	C. A. Lichty	C. A. Lichty	C. A. Lichty
Asst. Sec.	F. E. Weise	F. E. Weise		
Directors	W. T. Krausch	R. C. Henderson	G. A. Rodman	E. C. Neville
	R. C. Bardwell	J. S. Ekey	W. A. Batey	H. H. Best
	H. I. Benjamin	T. H. Strate	F. W. Hillman	J. E. King
	R. C. Henderson	G. A. Rodman	E. C. Neville	A. B. Scowden
	T. H. Strate	W. A. Batey	H. H. Best	W. A. Batey
	J. S. Ekey	F. W. Hillman	J. E. King	L. C. Smith

	1934-1935	1935-1936	1936-1937	1937-1938
President	H. I. Benjamin	T. H. Strate	E. C. Neville	C. M. Burpee
1st V.-Pres.	T. H. Strate	E. C. Neville	C. M. Burpee	F. H. Masters
2nd V.-Pres.	E. C. Neville	C. M. Burpee	F. H. Masters	W. S. Lacher
3rd V.-Pres.	A. B. Scowden	F. H. Masters	C. A. J. Richards	C. A. J. Richards
4th V.-Pres.	W. R. Roof	C. A. J. Richards	W. S. Lacher	F. H. Cramer
Sec.-Treas.	C. A. Lichty	C. A. Lichty	C. A. Lichty	C. A. Lichty
Directors	C. M. Burpee	A. L. McCloy	W. R. Roof	B. R. Meyers
	W. A. Batey	R. P. Luck	T. P. Soule	G. S. Crites
	L. C. Smith	H. H. Best	F. H. Cramer	R. E. Dove
	C. A. J. Richards	W. R. Roof	B. R. Meyers	T. P. Soule
	A. L. McCoy	T. P. Soule	G. S. Crites	A. Chinn
	R. P. Luck	F. H. Cramer	R. E. Dove	L. G. Byrd

	1938-1939	1939-1940	1940-1941	1941-1942
President	Armstrong Chinn	A. E. Bechtelheimer	H. M. Church	R. E. Dove
1st V.-Pres.	F. H. Cramer	F. H. Cramer	R. E. Dove	F. H. Soothill
2nd V.-Pres.	A. E. Bechtelheimer	H. M. Church	F. A. Soothill	G. S. Crites
3rd V.-Pres.	H. M. Church	R. E. Dove	G. S. Crites	A. M. Knowles
4th V.-Pres.	R. E. Dove	F. H. Soothill	A. M. Knowles	N. D. Howard
Sec.-Treas.	C. A. Lichty	C. A. Lichty		
Secretary	----------	----------	F. O. Whiteman	A. G. Shaver
Treasurer	----------	----------	F. E. Weise	F. E. Weise
Directors	L. G. Byrd	B. R. Meyers	N. D. Howard	R. E. Caudle
	W. R. Ganser	W. Walkden	L. G. Byrd	I. A. Moore
	F. H. Soothill	A. S. Krefting	K. L. Miner	W. A. Sweet
	B. R. Meyers	A. M. Knowles	R. E. Caudle	J. L. Varker
	W. Walkden	L. G. Byrd	I. A. Moore	L. E. Peyser
	A. S. Krefting	K. L. Miner	W. A. Sweet	Martin Meyer

	1942-1943	1943-1944	1944-1945	1945-1946
President	G. S. Crites	J. L. Varker	J. L. Varker	N. D. Howard
1st V.-Pres.	R. E. Caudle	R. E. Caudle	R. E. Caudle	F. G. Campbell
2nd V.-Pres.	A. M. Knowles	N. D. Howard	N. D. Howard	J. S. Hancock
3rd V.-Pres.	N. D. Howard	F. G. Campbell	F. G. Campbell	E. H. Harnhart
4th V.-Pres.	J. L. Varker	J. S. Hancock	J. S. Hancock	W. F. Martens
Secretary	A. G. Shaver†	Elinor V. Heffern	Elise LaChance	Elise LaChance
	Lorene Kindred‡			
	Elinor V. Heffern			
Treasurer	F. E. Weise	C. R. Knowles	C. R. Knowles	C. R. Knowles
Treasurer Emeritus		F. E. Weise	F. E. Weise	
Directors	M. Meyer	W. F. Martens	W. F. Martens	A. B. Chapman
	L. E. Peyser	A. L. McCloy	A. L. McCloy	W. A. Huckstep
	K. L. Miner	L. C. Winkelhaus	L. C. Winkelhaus	F. R. Spofford
	F. G. Campbell	E. H. Barnhart	E. H. Barnhart	Guy E. Martin
	J. S. Hancock	A. B. Chapman	A. B. Chapman	B. R. Meyers
	L. C. Winkelhaus	L. E. Peyser	L. E. Peyser	L. E. Peyser

†To November 1, 1962 ‡To February 1, 1943

	1946-1947	1947-1948	1948-1949	1949-1950
President	F. G. Campbell	J. S. Hancock	E. H. Barnhart	W. F. Martens
1st V.-Pres.	J. S. Hancock	E. H. Barnhart	W. F. Martens	W. A. Huckstep
2nd V.-Pres.	E. H. Barnhart	W. F. Martens	W. A. Huckstep	Guy E. Martin
3rd V.-Pres.	W. F. Martens	W. A. Huckstep	Guy E. Martin	F. R. Spofford
4th V.-Pres.	W. A. Huckstep	G. E. Martin	F. R. Spofford	Lee Mayfield
Secretary	Elise LaChance	Elise LaChance	Elise LaChance	Elise LaChance
Treasurer	C. R. Knowles	C. R. Knowles	L. C. Winkelhaus	L. C. Winkelhaus
Directors	Guy E. Martin	H. M. Harlow	Lee Mayfield	H. M. Harlow
	B. R. Meyers	H. B. Christianson	F. M. Misch	V. E. Engman
	L. E. Peyser	F. R. Spofford	W. D. Gibson	G. W. Benson
	H. M. Harlow	Lee Mayfield	H. M. Harlow	F. M. Misch
	H. B. Christianson	Franz M. Misch	V. E. Engman	L. R. Morgan
	F. R. Spofford	W. D. Gibson	G. W. Benson	J. A. Jorlett

	1950-1951	1951-1952	1952-1953	1953-1954
President	W. A. Huckstep	Guy E. Martin	F. R. Spofford	Lee Mayfield
1st V.-Pres.	Guy E. Martin	F. R. Spofford	Lee Mayfield	H. M. Harlow
2nd V.-Pres.	F. R. Spofford	Lee Mayfield	H. M. Harlow	J. A. Jorlett
3rd V.-Pres.	Lee Mayfield	H. M. Harlow	J. A. Jorlett	R. R. Gunderson
4th V.-Pres.	H. M. Harlow	J. A. Jorlett	R. R. Gunderson	W. H. Huffman
Secretary	Elise LaChance	Elise LaChance	Elise LaChance	Elise LaChance
Treasurer	L. C. Winkelhaus	L. C. Winkelhaus	L. C. Winkelhaus	L. C. Winkelhaus
Directors	F. M. Misch	M. H. Dick	W. H. Huffman	M. H. Dick
	L. R. Morgan	R. R. Gunderson	L. R. Morgan	J. F. Warrenfells
	J. A. Jorlett	J. F. Warrenfells	B. M. Stephens	G. Switzer
	M. H. Dick	W. H. Huffman	M. H. Dick	B. M. Stephens
	R. R. Gunderson	L. R. Morgan	J. F. Warrenfells	W. H. Bunge
	J. F. Warrenfells	B. M. Stephens	G. Switzer	E. R. Schlaf

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The 71-year-old swing span carrying the Staten Island Rapid Transit Railway over the Arthur Kill between Staten Island, N. Y. and Elizabeth, N. J., has been replaced by a modern lift bridge. And there's an interesting story behind the event. When the 496′6″ swing bridge was built in 1888, it was the longest in existence, a record it held for many years. It too, was fabricated and erected by American Bridge.

The imposing new bridge, with its 557′11½″ thru truss vertical lift span, is also a record-breaker.

But great length is not the only feature about the new bridge. It is an imposing structure from every angle. Big, but not as heavy as it looks because most of the 1,658 tons of steel in it are USS MAN-TEN; the towers are 33′ x 32′ in width and 163′4″ high; and even the vertical lift span itself is huge, being 43′4″ deep at the end and increasing to 70′ in the center. The old bridge, incidentally, will also be dismantled by American Bridge.

American Bridge has unmatched experience in railroad bridge construction. We have the know-how, the equipment and the personnel to handle such jobs with a minimum of interruption to traffic. We welcome an opportunity to discuss your bridge replacement or repair requirements. Just call or write the nearest office listed below.

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United States Steel

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South San Francisco • United States Steel International (New York), Inc., Export Distributors

	1954-1955	1955-1956	1956-1957	1957-1958
President	H. M. Harlow	J. A. Jorlett	R. R. Gunderson	W. H. Huffman
1st V.-Pres.	J. A. Jorlett	R. R. Gunderson	W. H. Huffman	M. H. Dick
2nd V.-Pres.	R. R. Gunderson	W. H. Huffman	M. H. Dick	B. M. Stephens
3rd V.-Pres.	W. H. Huffman	M. H. Dick	B. M. Stephens	H. D. Curie
4th V.-Pres.	M. H. Dick	B. M. Stephens	H. D. Curie	
Secretary	Elise LaChance	Elise LaChance	Elise LaChance	Elise LaChance
Treasurer	L. C. Winkelhaus	L. C. Winkelhaus	L. C. Winkelhaus	L. C. Winkelhaus
Directors	B. M. Stephens	J. F. Warrenfells	W. H. Bunge	G. W. Benson
	W. H. Bunge	H. D. Curie	E. R. Schlaf	J. M. Lowry
	E. R. Schlaf	J. M. Lowry	G. W. Benson	H. A. Matthews
	J. F. Warrenfells	W. H. Bunge	J. M. Lowry	T. M. von Sprecken
	H. D. Curie	E. R. Schlaf	T. M. von Sprecken	W. H. Bunge
	J. M. Lowry	G. W. Benson	H. A. Matthews	E. R. Schlaf

	1958-1959	1959-1960	1960-1961	1961-1962
President	M. H. Dick	B. M. Stephens	H. D. Curie	G. W. Benson
1st V.-Pres.	B. M. Stephens	H. D. Curie	G. W. Benson	J. M. Lowry
2nd V.-Pres.	H. D. Curie	G. W. Benson	J. M. Lowry	E. R. Schlaf
3rd V.-Pres.	G. W. Benson	J. M. Lowry	E. R. Schlaf	H. A. Matthews
Secretary	Ruth Weggeberg	Ruth Weggeberg	Ruth Weggeberg	Ruth Weggeberg
Treasurer	L. C. Winkelhaus	L. C. Winkelhaus	L. C. Winkelhaus	L. C. Winkelhaus
Directors	J. M. Lowry	W. H. Bunge	H. A. Matthews	R. C. Baker
	R. C. Baker	E. R. Schlaf	M. J. Hubbard	R. H. Miller
	W. H. Bunge	H. A. Matthews	R. C. Baker	Shirley White
	E. R. Schlaf	M. J. Hubbard	R. H. Miller	H. M. Wilson
	H. A. Matthews	R. C. Baker	Shirley White	R. D. Hellweg
	M. J. Hubbard	R. H. Miller	H. M. Wilson	F. W. Hutcheson

	1962-1963	1963-1964	1964-1965	1965-1966
President	J. M. Lowry	E. R. Schlaf	R. C. Baker	H. M. Wilson
1st V.-Pres.	E. R. Schlaf	R. C. Baker	H. M. Wilson	R. D. Hellweg
2nd V.-Pres.	H. A. Matthews	Shirley White	R. D. Hellweg	J. W. DeValle
3rd V.-Pres.	R. C. Baker	H. M. Wilson	J. W. DeValle	W. F. Armstrong
Secretary	Ruth Weggeberg	Ruth Weggeberg	Ruth Weggeberg	Ruth Weggeberg
Treasurer	L. C. Winkelhaus	E. F. Snyder	E. F. Snyder	E. F. Snyder
Directors	Shirley White	R. D. Hellweg	W. F. Armstrong	J. A. Goforth
	H. M. Wilson	F. W. Hutcheson	J. S. Ellis	E. R. Simmons
	R. D. Hellweg	W. F. Armstrong	J. A. Goforth	N. D. Bryant
	F. W. Hutcheson	J. W. DeValle	E. R. Simmons	A. R. Dahlberg
	W. F. Armstrong	J. A. Goforth	N. D. Bryant	J. S. Ellis
	J. W. DeValle	E. R. Simmons	A. R. Dahlberg	T. L. Fuller

	1966-1967	1967-1968		
President	R. D. Hellweg			
1st V.-Pres.	J. W. DeValle			
2nd V.-Pres.	W. F. Armstrong			
3rd V.-Pres.	J. A. Goforth			
Secretary	Ruth Weggeberg			
Treasurer	W. H. Huffman			
Directors	N. D. Bryant			
	A. R. Dahlberg			
	H. F. Lucas			
	J. S. Ellis			
	T. L. Fuller			
	R. A. Youngblood			
	V. D. Raessler			
	W. L. Short			
	C. E. Wachter			

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CONSTITUTION

ARTICLE I.

NAME

Section 1. This association shall be known as the American Railway Bridge & Building Association.

ARTICLE II.

OBJECT

Section 1.** The object of this association shall be the advancement of knowledge pertaining to the design, construction and maintenance of railway bridges, buildings, water service facilities, and other structures, by investigation, reports and discussions.

Section 2. The association shall neither indorse nor recommend any particular devices, trade marks or materials, nor will it be responsible for any opinions expressed in papers, reports or discussion unless the same have received the endorsement of the association in regular session.

ARTICLE III.

MEMBERSHIP

Section 1. The membership of this association shall be divided into five classes, viz: Members, life members, associate, honorary and junior members.*

Section 2.** A member shall be a person in a position above rank of gang foreman in connection with roadway bridge, building and water service work, or in the employ of a public regulatory body, a professor of engineering in a college, an engineering editor, or a government or private timber expert. Any person desirous of becoming a member shall make application upon the form prescribed by the executive committee, setting forth his name, age, residence and practical experience. He shall furnish at least three references to whom he is personally known. Applicants may be voted into membership at any regular executive meeting or by letter ballot of the executive committee, a majority vote being necessary in either instance.

Section 3.** To be eligible for a life membership a member must have belonged to the association for at least 15†† years and in general must have retired from active railway service due to age or physical disability. He shall have all the privileges of active membership, except the holding of office, and shall not be required to pay annual dues. The transfer from membership to life membership shall be made in the same manner as the election of members, as prescribed in Section 2, of this Article.

Section 4. Associates shall be responsible persons who are not eligible as members, whose pursuits or attainments qualify them to co-operate with members in the study and development of improved practices in the construction and maintenance of bridges, buildings and water facilities. They shall have all the rights of members except of voting and holding office. They shall be elected in the manner prescribed for members, in Section 2 of this Article.

Section 5. Honorary members shall be chosen from persons who have attained acknowledged eminence in some branch of engineering or railway service. Their number shall be limited to ten. Honorary members shall be proposed by not less than six active members and shall be elected by the unanimous vote of the members present at a regular meeting. They shall have all the rights of active members except that of holding office and shall be exempt from the payment of dues.

Section 6. A junior member shall be a person who is a graduate of a recognized engineering school, or who has been employed for at least two years in the design, maintenance or construction of railway bridges, buildings or structures. Applicants shall be at least 21 years of age and they shall be elected in the manner prescribed for members, in Section 2 of this article. Juniors shall have all the rights of members except that of holding office. When the attainments of a Junior are such as a qualify him as a member, he may apply for promotion and the executive committee shall authorize such promotion when qualifications warrant the action. Unless a Junior is promoted, his membership shall cease automatically when he becomes 28 years of age.*

Section 7. Any member guilty of conduct unbecoming to a railroad officer and a member of this association, or who shall refuse to comply with the rules of this asso-

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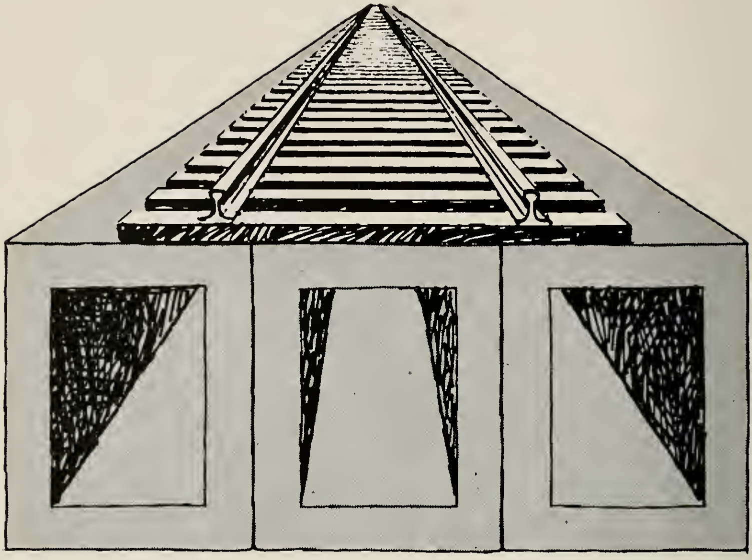
* Amended October 16, 1941.
** Amended September 20, 1948.
†† Amended March 10, 1958.



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ciation, shall forfeit his membership on a two-thirds vote of the executive committee.

Section 8. Membership shall continue until written resignation is received by the secretary, unless member has been previously expelled, or dropped for non-payment of duties in accordance with Section 1 of Article VII.

Section 9.** Only active members shall hold office in this association, and only active and life members shall be entitled to vote in the election of officers.

ARTICLE IV.

OFFICERS

Section 1§. The officers of the Association shall be a president, three vice-presidents, a secretary, a treasurer and nine directors, who, with the most recent past president, shall constitute the Executive Committee.

Section 2. The past presidents of this association, previous to the most recent past president, who continue to be members, shall be privileged to attend all meetings of the executive committee, at which meetings they shall receive due notice, and be permitted to discuss all questions and to aid said committee by their advice and counsel; but said past presidents shall not have a right to vote, unless called upon to fill a quorum.

Section 3. Vacancies in any office shall be filled for the unexpired term by the executive committee without delay.

ARTICLE V.

EXECUTIVE COMMITTEE

Section 1.** The executive committee shall manage the affairs of the association and shall have full power to control and regulate all matters not otherwise provided for in the constitution and by-laws and shall exercise general supervision over the financial interests of the association, and make all necessary purchases and contracts required to conduct the general business of the association, but shall not have the power to render the association liable for any debt beyond the amount then in the treasury plus accounts receivable and not subject to other prior liabilities. All appropriations for special purposes must be acted upon at a regular meeting of the association.

Section 2. Meetings of the executive committee may be called by a majority of the members of the committee, providing 10 days' notice is given members by mail.

Section 3. Five members of the executive committee shall constitute a quorum for the transaction of business.

ARTICLE VI.

ELECTION OF OFFICERS AND TENURE OF OFFICE

Section 1. Except as otherwise provided the officers shall be elected at the regular annual meeting of the association and the election shall not be postponed except by unanimous consent of the members present at said annual meeting. The election shall be by ballot, a majority of the votes cast being required for election. Any active member of the association not in arrears for dues shall be eligible for office, but the president shall not be eligible for re-election.

Section 2.§ The president, three vice-presidents, secretary and treasurer shall hold office for one year and the directors for three years, three directors being elected each year. All officers shall retain their office until their successors are elected and installed. A director elected for a three-year term shall not be eligible to serve two consecutive terms.

Section 3.† The term of office of the secretary and the treasurer may be terminated at any time by a two-thirds vote of the executive committee. Their compensation shall be fixed by a majority vote of the executive committee.

The secretary shall also serve as secretary of the executive committee.

Section 4. The secretary and the treasurer shall be required to give bond in an amount to be fixed by the executive committee.

ARTICLE VII.

MEMBERSHIP FEE AND DUES

Section 1.† Every member upon joining this association shall pay to the secretary an entrance fee and dues as prescribed by the executive committee. No member in

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* Amended October 16, 1941.
** Amended September 20, 1948.
† Amended September 21, 1957.
§ Amended September 28, 1966.

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MULTI-PLATE proves economical for industrial engine tunnel

In building a new railroad yard, it was necessary to provide a way for a brick yard engine to cross from one side of the yard to the other. Armco MULTI-PLATE® Pipe, 16 feet in diameter and 440 feet long, was an economical solution. The structure, 5 percent ellipsed and supplied in 3-gage steel, was assembled in position and then backfilled. There were no forms to build, no waiting for curing, no construction delays.

Armco MULTI-PLATE drainage structures—full-round pipe, arches supported by foundations, and pipe-arch that provides maximum waterway under limited headroom conditions—have been used for decades by railroads. These corrugated steel conduits are easy to erect, go in fast, and have a record for durable service. Sizes range up to 26 feet in full-round pipe.

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ARMCO STEEL ARMCO

arrears for annual dues shall be entitled to vote at any election and any member more than one year in arrears may be stricken from the list of members at the discretion of the executive committee.

Section 2.‡ A person stricken from the list of members because of non-payment of dues, upon written application may be reinstated as a member in his former class without loss of privileges, either upon payment of all back dues (which must accompany applicants) or at the discretion of the executive committee voting in the manner prescribed in Section 2, Article III.

ARTICLE VIII.*

LOCAL SECTIONS

Section 1.** Upon the application of ten or more members of the association residing in the same geographical district, or having offices therein, the executive committee shall organize a local section for that district, to which all members in that district shall be eligible. Such local section shall admit to active membership only members in good standing. It shall hold not less than two meetings each year, and shall be governed by such constitution and by-laws not inconsistent with the constitution of this association as the section membership may adopt and the executive committee approve.

Section 2. The parent association shall not be put under any obligation, either financial or in the matter of policy or opinion, by any local section.

ARTICLE IX.

AMENDMENTS

Section 1. This constitution may be amended at any regular meeting by a two-thirds vote of the members present, provided that notice of the proposed amendment or amendments has been sent to the members at least 30 days previous to said regular meeting.

By-Laws

TIME OF MEETING

1.** The regular meeting of this association shall convene annually during the month of September, the exact date to be fixed by the executive committee.

PLACE OF MEETING

2.** The place of holding the annual convention shall be Chicago, Ill.

3. It shall be within the power of the executive committee to change the location or time of the meeting if it becomes apparent that it is for the best interests of the association.

QUORUM

4. At the regular meeting of the association, 15 or more members shall constitute a quorum.

**DUES

5. The annual dues, for the fiscal year ending August 31, and payable in advance, shall be as follows:*

Members, $7.00; Associate Members, $7.00; Junior Members, $5.00.

DUTIES OF OFFICERS

6.† The president shall have general supervision over the affairs of the association. He shall preside at all meetings of the association and of the executive committee; shall appoint all committees not otherwise provided for, and shall be ex-officio member of all committees. He shall with the secretary sign all contracts or other written obligations of the association which have been approved by the executive committee.

---

† Amended October 17, 1940.

* Article adopted 1922.

** Amended September 20, 1948.

‡ Amended September 21, 1957.

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75 years*

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**Binks
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Company**

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He shall render a detailed report at least three times during the year to the members of the executive committee, showing the financial condition of the association and its activities.

At the annual meeting the president shall present a report containing a statement of the general conditions of the association.

7. The vice-presidents in order of seniority shall preside at meetings in the absence of the president and discharge his duties in case of a vacancy in his office.

8.† It shall be the duty of the secretary to keep a correct record of the proceedings of all meetings of this association, and of all accounts, between this association and its members; to collect all moneys due the association, and deposit the same in the name of the association. He shall pay all bills when properly certified and approved by the president and the treasurer, and make such reports as may be called for by the executive committee. He shall also perform such other duties as the association may require.

9.‡ The treasurer shall have charge of the funds, check all deposits as made by the secretary, sign all checks after they have been approved by the president, and invest all funds not needed for current expenses as directed by the executive committee. He shall report at each annual meeting on the condition of the finances.

NOMINATING COMMITTEE

10.♯ After each annual meeting the president shall appoint a committee consisting of five members. Two Past Presidents shall be members of this committee, one of whom shall act as Chairman. No other officers of the Association shall be appointed to this committee. This committee shall prepare a list of names of nominees for officers to be voted on at the next annual convention in accordance with ARTICLE VI of the Constitution, said list to be read at the business session of said convention. Nothing in this section shall be construed to prevent any member making further nominations.

AUDITING COMMITTEE

11.‡ Prior to each annual meeting the president shall appoint a committee of three members, not officers of the association, whose duty it shall be to examine the accounts and vouchers of the secretary and the treasurer and certify as to the correctness of their accounts.

COMMITTEE ON SUBJECTS FOR DISCUSSION

12. After each annual meeting the president shall appoint a committee whose duty it shall be to prepare a list of subjects for investigation to be submitted for approval at the next convention.

COMMITTEE ON INVESTIGATION

13. After the association has adopted the list of subjects for investigation the president for the succeeding year shall appoint the committees who shall prepare the subjects for report and discussion. He may also appoint individual members to prepare reports on special subjects, or to report on any special or particular subject.

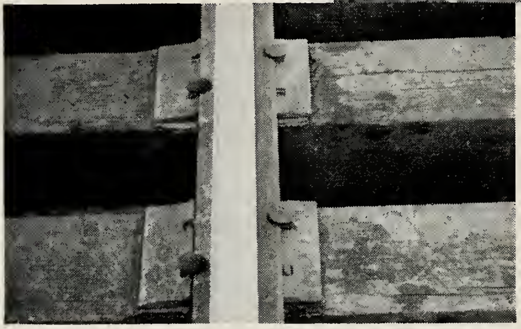
PUBLICATION COMMITTEE

14. After each annual meeting the executive committee shall appoint a publication committee consisting of three active members whose duty it shall be to cooperate with the secretary in the issuing of the publications of the association. The assignment of this committee shall be such that at least one member shall have served on the committee during the previous year.

---

† Amended October 17, 1940.
‡ Adopted October 17, 1940.
° Amended June 22, 1964.
°° Amended September 20, 1948.
♯ Amended December 4, 1950.

WHY SWITCH TO LARGER TIE PLATES?



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Note excellent condition of these ties after 9 years' service on railroad bridge spanning the Ohio River at Louisville, Kentucky. 7½" x 10" tie plates were installed with *Bird Self-Sealing Tie Pads* when ties were new in 1948. Vulnerable underplate and spike hole areas are in as good condition today as they were 9 years ago. (Photos courtesy of Kentucky & Indiana Terminal Railroad.)

Here's conclusive proof that smaller tie plates, used with Bird Self-Sealing Tie Pads, carry the load satisfactorily while affording better protection than larger tie plates without pads. This bridge installation, on a 6° curve, is subjected to the heavy tonnage of three railroads. After nine years of service, Bird Self-Sealing Tie Pads are still firmly sealed to the tie. The vulnerable underplate and spike-hole areas of the ties are in as good condition as the day they were installed. Moisture and abrasive materials could not penetrate the effective seal of the pad to the tie.

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ORDER OF BUSINESS

15.† Call to order by president.
Opening prayer or invocation.
President's address.
Report of secretary.
Report of treasurer.
Appointment of special committees.
Reports of standing committees and presentation of papers.
Unfinished business.
New business.
Election of officers.
Installation of officers.
Adjournment.

DECISIONS

16. The votes of a majority of the members present shall decide any questions, motion or resolution which shall be brought before the association, unless otherwise provided. Unless specifically provided herein otherwise, all discussions shall be governed by Robert's rules of order.

AMENDMENTS

17.† The By-Laws can be amended by a two-thirds vote of those present at any regularly called executive committee meeting.

---

† Amended September 20, 1948.

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The iron silicate in 4-D Wrought Iron actually *puts corrosion to work.* 4-D's mechanical barrier of fibers detours corrosion and forces it to extend over the surface of the metal in an adherent, *protective* coating. Only 4-D Wrought Iron offers this kind of protection from corrosion.

WHAT ABOUT FATIGUE FAILURE?

In resisting fatigue, the iron silicate fiber network is again the key. With most metals, fractured ends correspond to a broken lump of sugar. Fibrous 4-D Wrought Iron, when fractured, resembles a splintered hickory plank. 4-D's unique structure minimizes stress concentrations caused by shock and vibration—prevents early fatigue failure.

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The Conley Sliding Joints use a wing rail to relieve welded rail track expansion and contraction, which frequently causes track buckling, spreading, spike pulling, pull-aparts and other damages that interrupt traffic.

●

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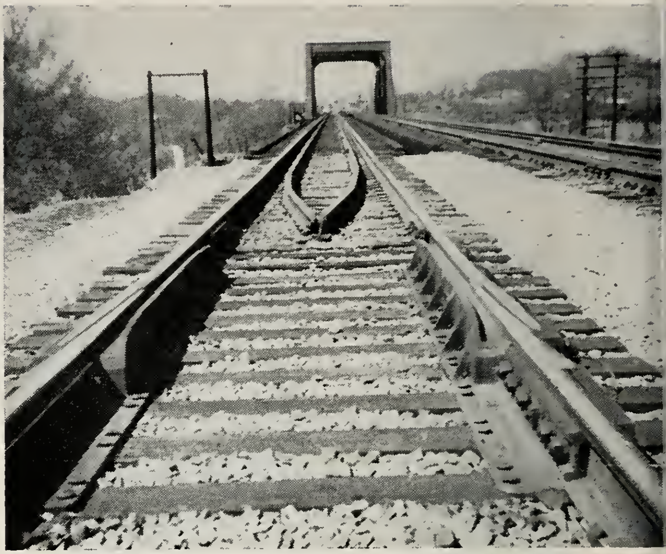

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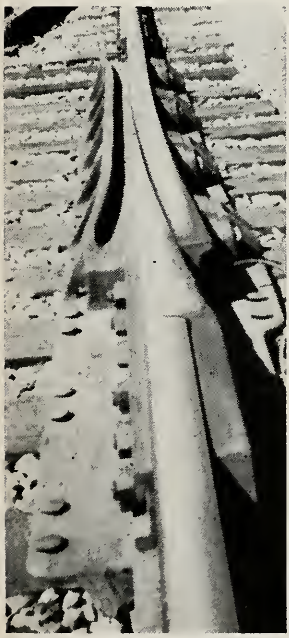

Take a good look at the above photo. It shows you how the Conley Sliding Joint wing rail moves to relieve expansion or contraction of welded track. The units require practically no maintenance.

Engineered for dependable operation and built for la ing ruggedness, Conley Sliding Joints effectively a positively compensate for the expansion and contra tion of welded track rails.

The Conley Sliding Joint installation pictured above shows the heavy wheel tread provided at all times regardless of how much expansion, or contraction is taking or has already taken place. These sliding joints with extra heavy wheel-guide rails, weigh over 2,400 pounds each.

Each unit is complete within itself. Each one functions independently of the other. Each is fully automatic and responds solely to the variations indu by temperature changes whether hot or cold. Th joints are non-freezing, n binding, non-locking and n buckling. The sliding wing r move only, if and when te perature changes.

Use Conley Sliding Joints trestles, curves or in ot critical locations where rail pansion and contraction must relieved.

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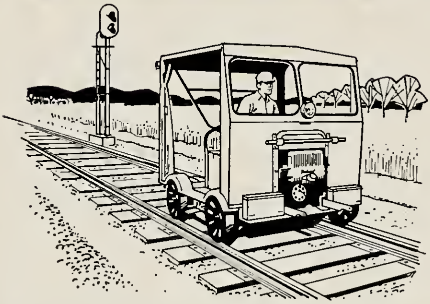

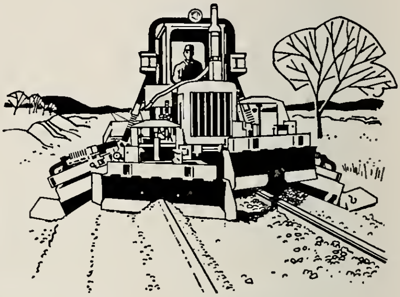

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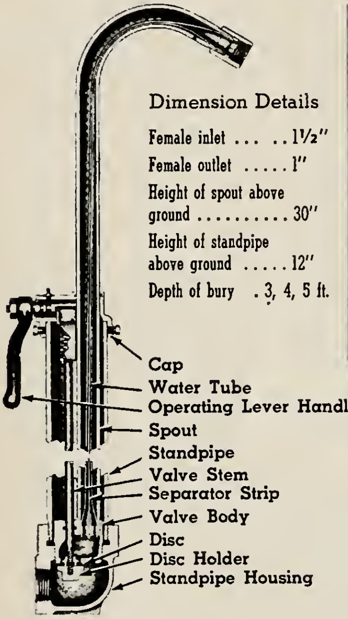

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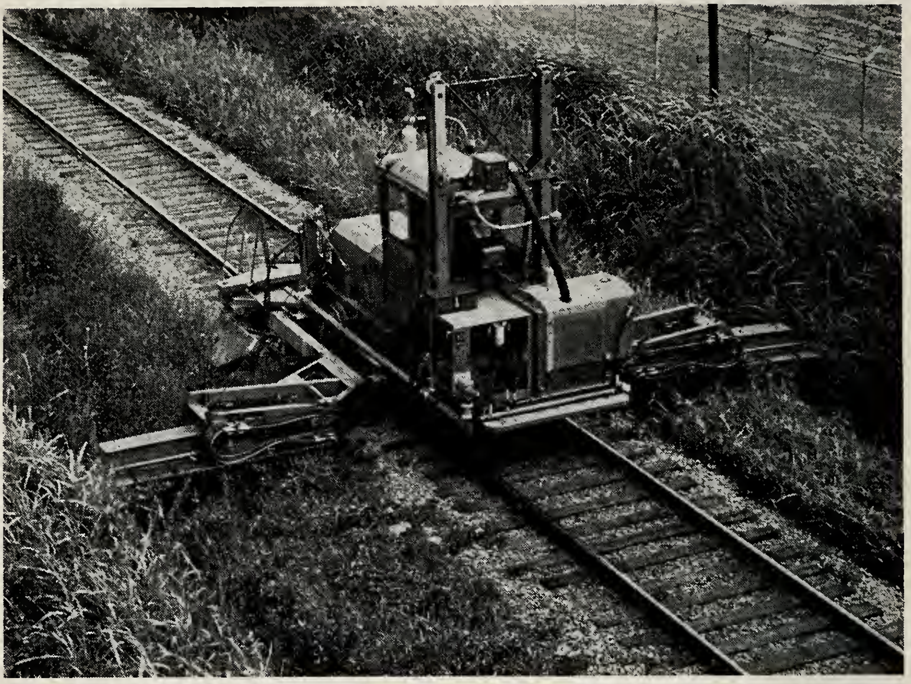

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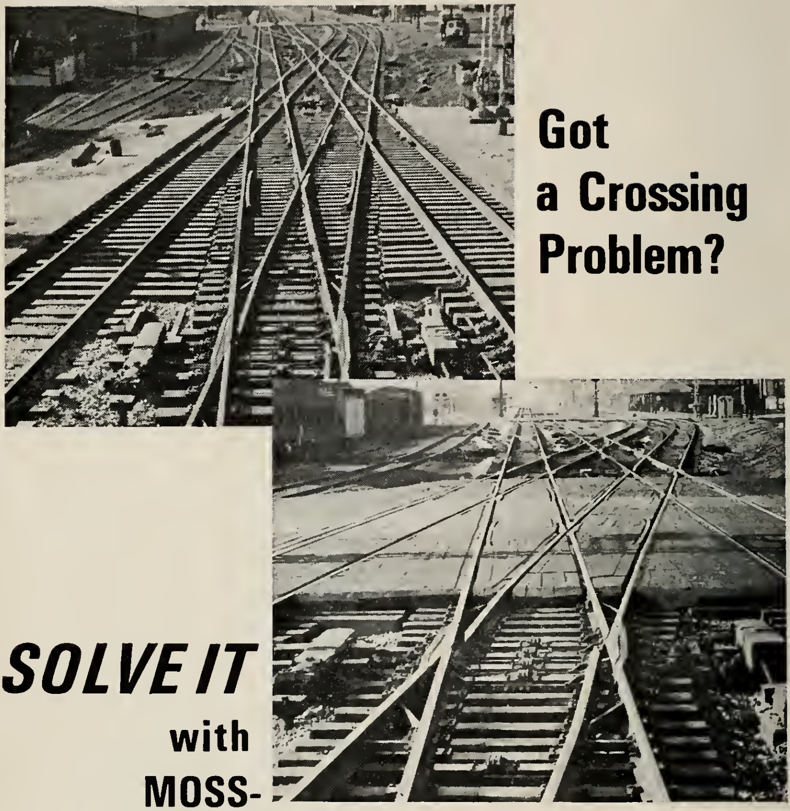

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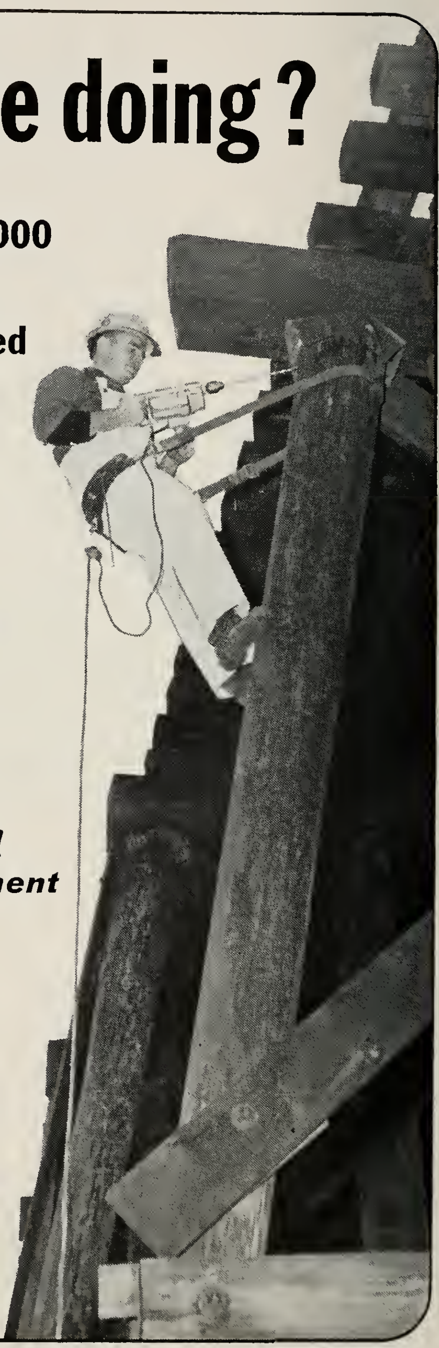

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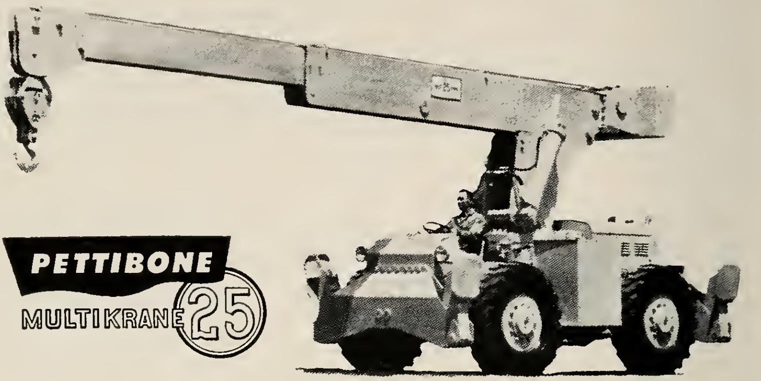

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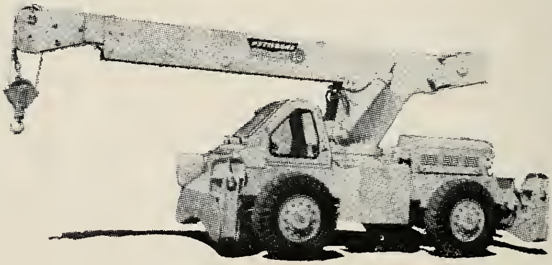

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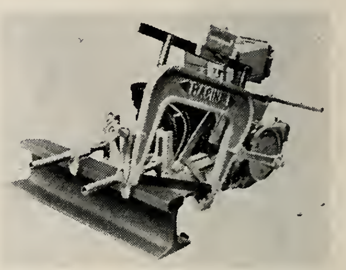

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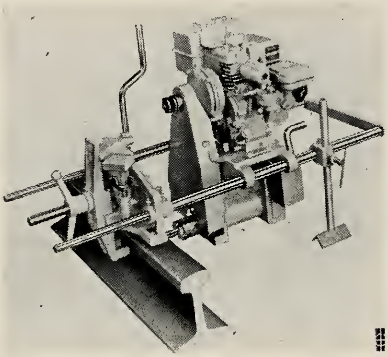

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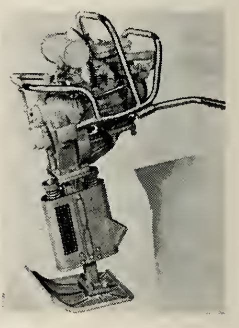

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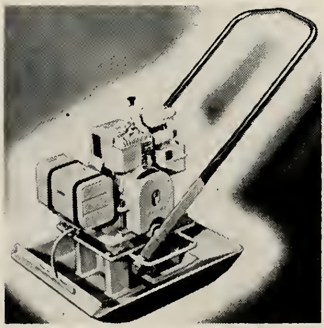

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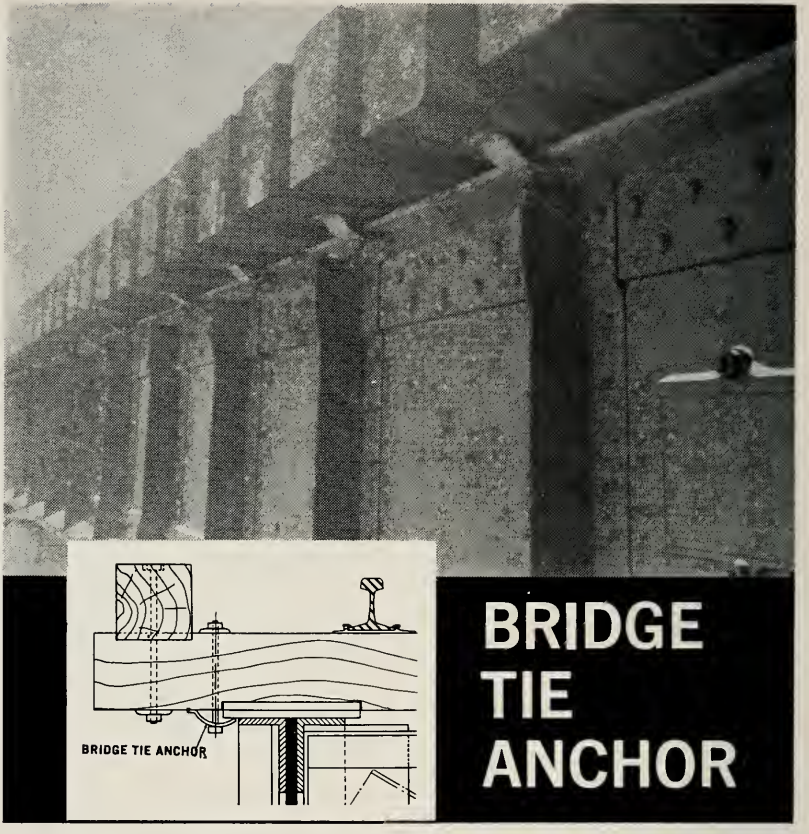

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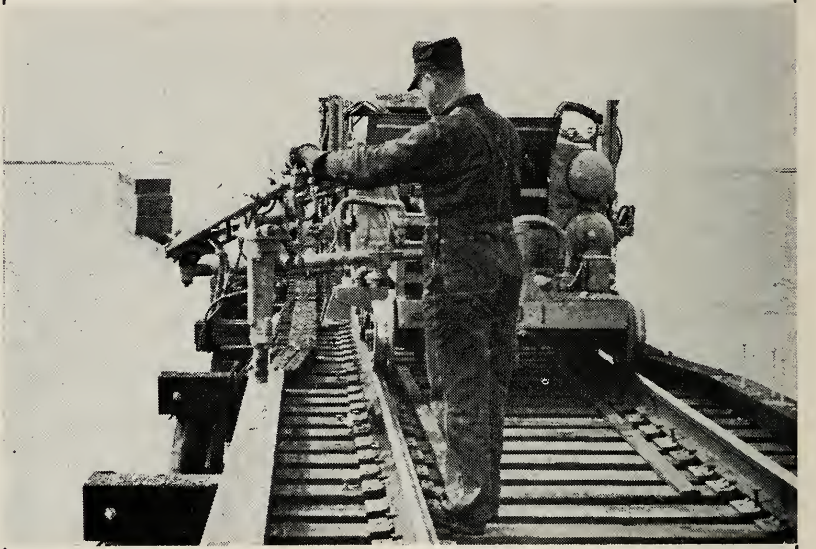

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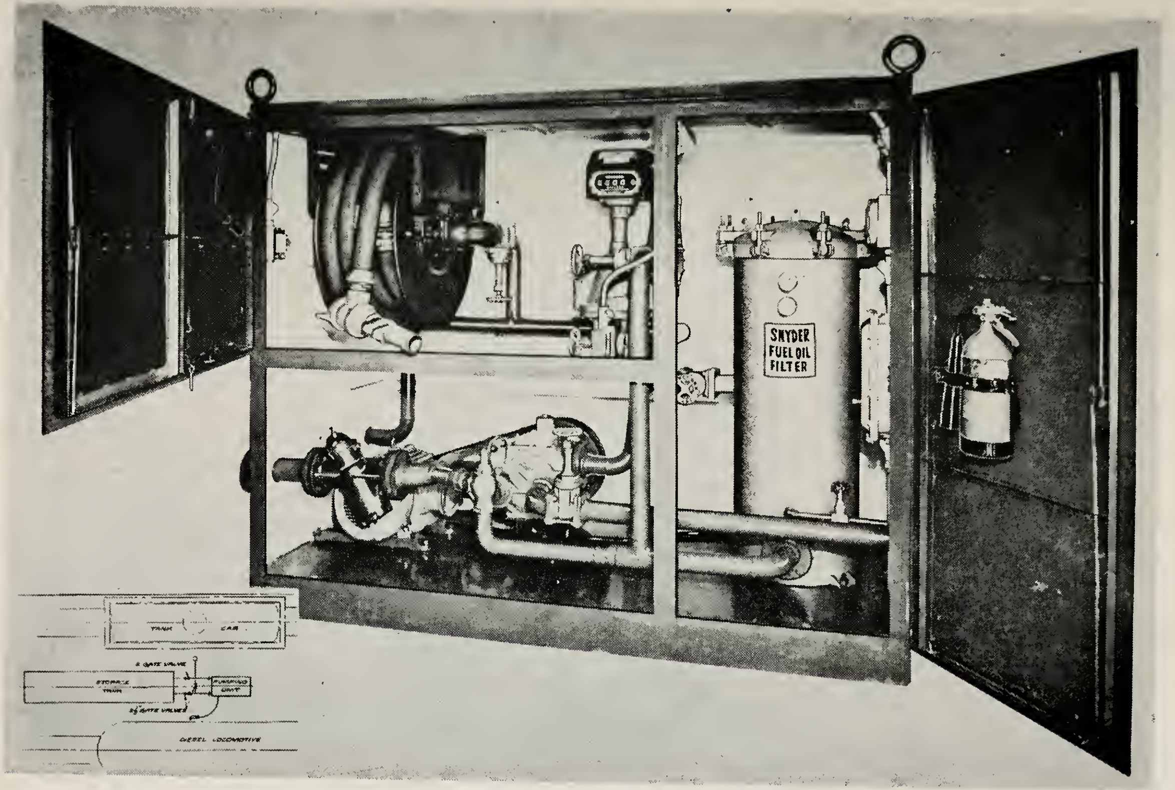

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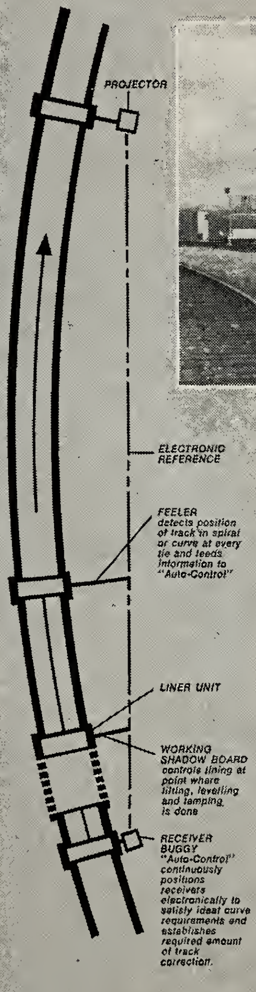
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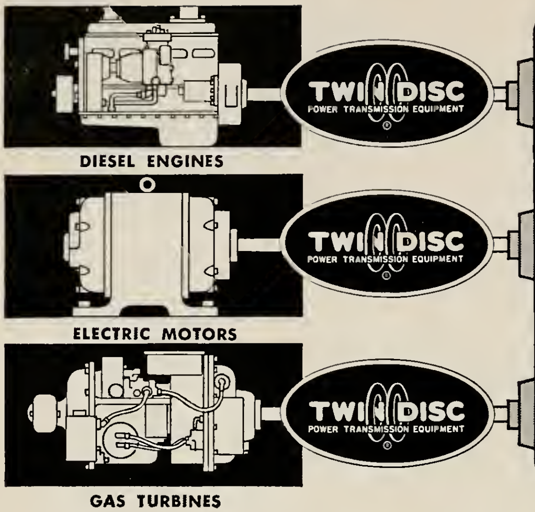
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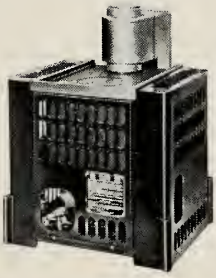

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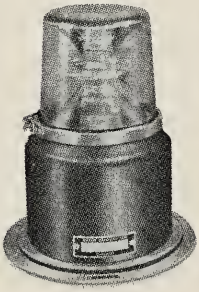

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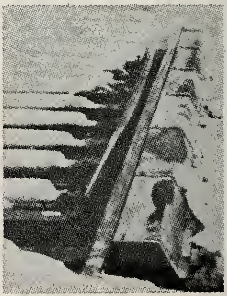

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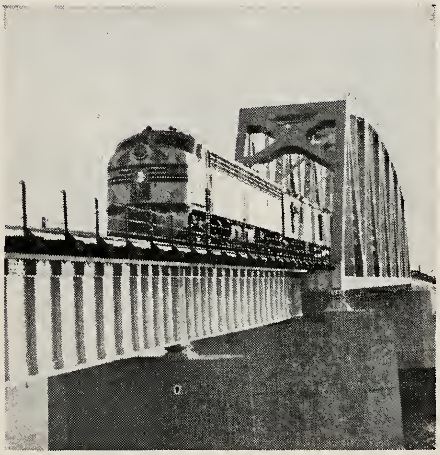

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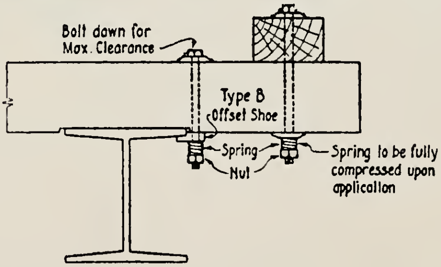
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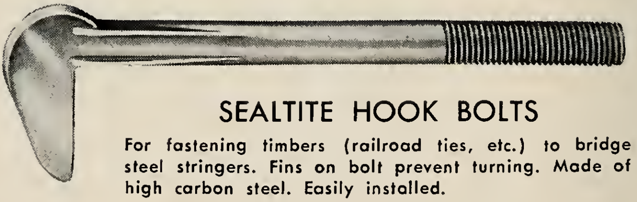

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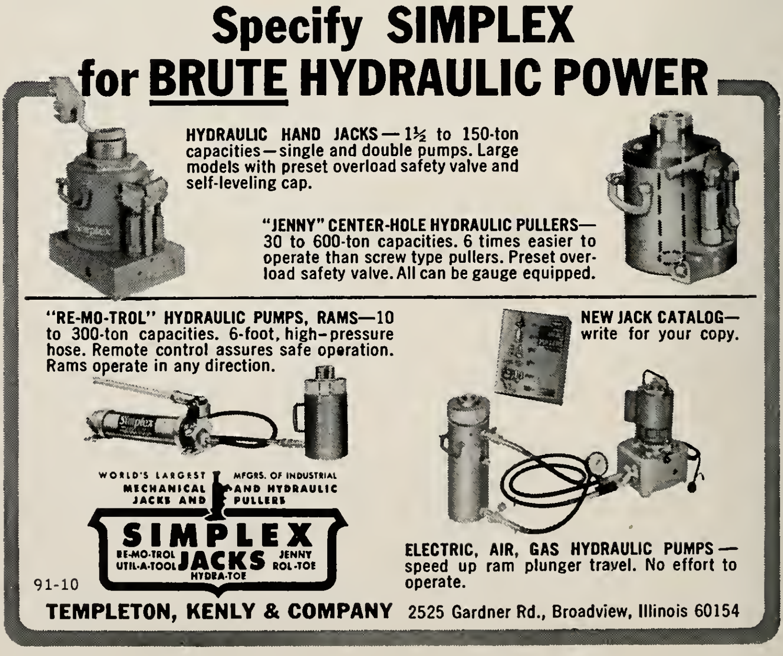

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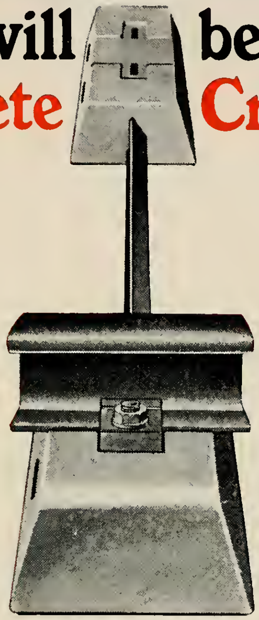

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